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ESSE V. HATHAWAY

THE BOOK OF AMERICAN PRESIDENTS

THE ROMANCE OF THE AMERICAN MAP

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ESSE V. HATHAWAY

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Foreword.

THERE once was a time when distance erected high barriers between peoples of the earth. In fact that time can easily be remembered by men and women living today. But with a plane taking off from London this morning, to skim New York's sky line tomorrow, with carols from Cape Town filling our American ears on Christmas Day, with voices of kings, of dictators, of world heroes, of just plain folk, echoing through our homes, any hour of any day—such barriers are crumbling.

And as they crumble, we—you and I—are finding ourselves no longer just members of one family, shut off behind home walls; no longer just neighbors of the family next door; no longer even just citizens of state and nation; but members, instead, of the whole human race: citizens, instead, of the world. A world of bewildering differences in ideals of government, in religions, in ways of everyday living. But a world, as well, where exist certain fundamentals for all right living, as familiar, apparently, to men of the Old World as they are to those of the New, as familiar, also, to men of long ages past as to those living now.

Fundamentals which act as broad beams on which to build common meeting places. Such a meeting place

as I have tried, for example, to set up within the covers of this book, where we may find men and women brought together from other centuries and from widely scattered lands. Men and women who are here because they were the first to lead out in medical science, in mechanical inventions, and in a better understanding of their fellow human beings.

Many who followed these pioneers, many who made first contributions in other important lines of development have had to be omitted. Perhaps, however, the company is great enough, varied enough in time and country, to prove that men and women have risen above all confusing differences and in so doing have wrought priceless gifts for all times and all men. Gifts for you and me. Once they are accepted—with conscious gratitude and understanding for the price paid for them—our own sky line begins to lift. And the cloud rising from those crumbling barriers begins to disappear, leaving us with a clearer vision, a readier heart to walk out into our own full place among the whole world of men.

ESSE V. HATHAWAY.

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September, 1935.

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PART ONE

Through Health

"Two opposing laws seem to me now in contest. . . The one places a single life above all victories, the other sacrifices hundreds of thousands of lives to the ambition of a single individual. . . . Which of these laws will prevail, God only knows. But of this we may be sure, that science, in obeying the laws of humanity, will always labor to enlarge the frontiers of life."

—Louis Pasteur

I. *One Eternal Fight.*

Hippocrates

From the time he could first remember, the Greek youth Hippocrates had watched the islanders of Cos wind down the mountain trails bringing their sick to the temple of Aesculapius, the ancient god of medicine. He saw them bring other things also—wines from their sloping vineyards, purple dyes of rare beauty—to trade with the merchants whose many-colored sails put into the harbor from the sunny Mediterranean. He listened like any other curious youth when islanders, merchants, villagers gathered under the wide shade of the old plane tree to talk of what the great Pericles was doing in Athens. He sat in rapt, proud silence to discussions of the latest wise sayings of great philosophers and the deeds of brave men. He was stirred by long, ringing passages from plays or poems by Sophocles, Aeschylus, Euripides, Anacreon, and Pindar. For he and his people were Greeks whose ancestors had come from the city of Epidaurus which stood on a promontory thrusting its tip into the sea not far from fair Athens itself.

As young Hippocrates watched, listened, dreamed with the other islanders, however, his mind was never quite free from what might be going on beyond the

white pillars of the temple between which he saw the sick and helpless disappear. For the father of Hippocrates could trace his ancestry back to Aesculapius and could trace much of his wisdom in caring for the islanders of Cos across the blue sea to where in a beautiful little valley about eight miles from Epidaurus the largest of all the temples to the god of medicine had been erected. There, while the temple itself was kept sacred to the worship of Aesculapius, buildings near by were given over to the care of the sick and to recreation for convalescents. There famous festivals were held every four years to do honor to the god of healing.

No doubt many tales were told under that old plane tree of what went on in the valley of Epidaurus—tales burdened with the superstitious fear of the age, which, brilliant as it was, was still the fifth century before Christ. Men might be talking with marvelous wisdom in Athens. Pericles might be reigning magnificently. But before the onslaughts of disease, people were still being swept down as they had been ever since man could remember. Nevertheless, there was something about those years which caused men's minds to leap forward in magnificent visions. And young Hippocrates, listening, looking out across the sea toward Epidaurus, looking back to the temple on his own island where his grandfather and his father labored to stifle the moans of their patients with all sorts of supernatural chants, charms, and dark magic, began to question much of what was going on in the name of Aesculapius.

Hippocrates

Just when doubt began to disturb the youth's mind no man really knows. After all, twenty-four hundred years, or over, is a long, long time for man's memory to cover. It becomes even longer when the distance in miles stretches away to the remote island of Cos lying off the coast of Asia Minor. Not so long, however, either in years or in miles but that the distance began to be bridged when young Hippocrates started out to settle his doubt. He had not gone far before he satisfied himself that *natural* causes, not *supernatural*, were behind the diseases laying his fellow islanders low.

That one fact and what its establishment meant for the beginning of scientific procedure in curing and treating disease are about all that is definitely known in the life of Hippocrates. Even his birth year is uncertain. It was somewhere around 460 B.C. His mother's name was Herades, a name whose descent mythology traces from Hercules. Perhaps that ancestry accounts in part for her son's reverence for health, for his desire to make more possible a splendid strength of body for his fellow men. Besides, there was his father's kin serving the god of medicine through generations. Quite naturally Hippocrates began early to do the same. He traveled widely. He studied, taught, practiced medicine in Thrace, Thessaly, Delos, and Athens. While in Thrace he studied not only the treatment of disease but how to build up health through exercise. He fought the plague in Athens. His fame spread. The story runs that the ruler of Persia sent for him

to fight the plague in that country. But the Persians were enemies of Greece, and Hippocrates answered,

> I have in my own country the food, the clothing, and the habitation I require. As a Greek it would be unworthy of me to aspire to the riches and grandeur of Persians and to serve the foes of my country and liberty.

That reply sent the haughty Persian ruler off into a fury of offended dignity. He ordered Cos to deliver her rebellious son to him. But sturdy little Cos staunchly refused. And Hippocrates lived on, observing the sick, recording what he saw, building up his mass of proof that disease developed from natural, not supernatural, causes and therefore should be treated with scientific remedies, rather than with charms, prayers, or incantations. Some say he reached the age of eighty-five. Some, that he passed the century mark.

Whatever his years, they were sufficient for him to make an amazing contribution to the welfare of the human race. What that contribution cost him nobody knows. But no man has ever tried to oppose a people's belief in the supernatural, to set up a reasonable scientific truth against a faith in old-time charms and magic, without paying a bitter price for his efforts. Hippocrates must have done so while his own flesh and blood cowered before an expected thunderbolt from Olympus.

Hippocrates seems, also, to have been as wise as he was courageous. Other schools of medicine filled the

air with their outraged shoutings against him. In the midst of the din he went his way serenely, making no answer. No traditional belief, no preconceived theory affected him. Nothing came between him and the proof of his own observations. Nothing was allowed to be recorded in his notes except what he saw with his own eyes. Steadily those notes heaped high, concise and unprejudiced. Immediately after his death they were taken over by his followers, who added to them in what is known as the Hippocratic Collection. How much of this collection is made up of the personal work of Hippocrates is not certain, but there is nothing in it which does not bear the stamp of his belief. That collection was nearing completion about 300 B.C.

The facts of his life may be few. The disputes may be many regarding what are actually his observations and what are not in this collection bearing his name. Nevertheless, men of science today stand united in reverence for the contribution Hippocrates made to medicine and through that contribution to the human race. His physician's oath is as familiar to the youth of the medical world this year as it was to those living in those long-ago years before the birth of Christ. Nothing has been found to surpass it in its high ideals of professional loyalty. Nothing more exacting has been set up than its ideal of professional responsibility. Nothing can surpass the simplicity of the following, which has come ringing down through all the centuries as an ideal of all service rendered by one man for another:

The love of humanity associated with love of his craft; the joy of working joined to a true love of his brother.

Galen

But no one man, single-handed, has ever been able to lift a whole people clear from long centuries of any belief. Because of that fact, many of the islanders of Cos, and others in the various countries of the civilized world, kept right on believing just as they had before Hippocrates struck his staggering blow at the Olympian creed of Aesculapius. The human body was still looked upon as something sacred into whose secrets no man had the right to pry. Various spirits, it was believed, had the directing of the work of that body, and woe betide any man who interfered with those spirits. Even to Hippocrates the mysteries of the human body remained very largely unexplained. But within the century of his death, other men were daring the wrath of the gods in the solving of those mysteries. Herophilus of Chalcedon first dissected a human body in public. He announced, among other things, that the brain was the central organ of the nervous system, and that the arteries and veins had their own separate functions to perform. For these fundamental discoveries, he is still called the father of anatomy, since through them man had his first glimpse of body structure.

In the same way, through Erasistratus of Chios, a younger man living at the same time, men had their

first glimpse of how that body worked. For through his observations Erasistratus concluded that the veins carried blood, that the lungs took in air, that every organ had its veins, arteries, and nerves. He saw a nice balance between all these organs, and because he did, he was very emphatic in his warning against strong remedies that might upset that balance. In the place of those remedies, he advised exercise, a regulated diet, and vapor baths. If Hippocrates is called the Father of Medicine, if Herophilus is known as the Father of Anatomy, then, surely, Erasistratus has a right to his title of Father of Physiology. Through him men began to understand, dimly, the workings of the human body.

And then, about five hundred years after Hippocrates had startled the good priests of Cos by denying the power of the gods to cause or cure disease by some cant or charm, Galen was born in Pergamus, the capital of Asia Minor, where the worship of Aesculapius was as devout as ever it was in Cos. His father, Nicon, was a man of high standing in Pergamus; he was an architect, who added to his professional knowledge a sound learning in astronomy and geometry. His mother, sad to say, was better known for her sharp tongue and violent temper than for learning. The story runs that she had a habit of biting her maids to punish them. If Galen inherited his love of medicine from his father, quite as surely he inherited his temper from his mother, a temper which led him later to quarrel endlessly with his professional brothers.

The boy's life on the whole was one of pleasant interests. He had excellent teachers. He became familiar with all the various schools of thought influencing men of his time—Stoic, Platonic, Epicurean; a familiarity as common then as that of a twentieth century boy with the multiplication table. But while he followed all those interests, none of them beckoned him, none of them challenged him as did the study of medicine. Who knows how much of that fascination came from watching the treatment of the sick in the temple of Aesculapius, how much from learning of the work of Hippocrates? Cos was not far from the coast of Asia Minor. The Hippocratic Collection was the talk of all men interested in learning as his father was.

Whatever the influence, by the time he was sixteen, Galen knew that nothing in the world mattered so much to him as his desire to study medicine. So he began. Two years later he was in Smyrna working under Pelops, one of the famous physicians of his time. He traveled much. He saw the great trading centers and talked with great men of Greece, Phoenicia, Palestine, Cyprus. He ended his student days in Alexandria—Alexandria, where ships from the whole known world put into port, where all races came together, where all the great philosophers of the day met to argue, teach, and dream of what lay ahead in the world. And where he had his chance—the chance meaning more to him than anything else in life—to study the bones of the human skeleton.

With all the knowledge of those years, with all the colorful zest of his long travels, with his contact with men from distant lands, Galen returned to Pergamus at twenty-eight to begin his practice. At first he was put in charge of the wounded gladiators who had gone down in the arena of his city. But riots broke out in Pergamus and six years later he fled to Rome. There, largely abandoning the surgery of his earlier years, he devoted himself to medicine. Confusion, however, abounded in the world of medicine. Rome was full of different schools of thought on the subject. Galen, ambitious, successful, brilliant not only in medicine but in philosophy, expressed himself freely—with that sharp, acid tongue inherited from his mother—concerning all beliefs with which his own knowledge caused him to differ. Naturally he made enemies. Men said his tongue was far more skilled in cutting than his fingers. They accused him of using black magic. Rome became anything but a pleasant place for him.

And then came a plague. The riots having quieted down in Pergamus, Galen again fled—this time homeward. But even if some of the men of his profession did hate him, the great Emperor Marcus Aurelius knew him to be a skilled physician. That Emperor needed such a man as Galen to attend his soldiers on an expedition against some Germanic tribes. So he recalled him. But Galen was shrewd. Perhaps he thought that he was worth far more to the world as a physician of peace than of war. At any rate he claimed to have had a

dream in which Aesculapius, the god of medicine himself, had appeared and demanded that he, Galen, remain in Rome. Immediately, Marcus Aurelius, not daring to risk the wrath of the gods, reconsidered his command and ordered Galen to take charge of the health of his heir, the young Commodus. After that very little is known of Galen's life, except that he continued his lecturing, that many of his valuable papers were destroyed by a fire, and that he died probably in Sicily in 200 A.D.

But there is no question about what he left to this world as his contribution to the better health of the human race. There are his five hundred treatises beautifully written in the best of Greek, dealing not only with medicine but with the philosophies of his time. But it is to his medical works that men turn, wondering at his ability to draw together in an organized manner all worthwhile discoveries and beliefs from the scores of differing medical schools at Alexandria, at Athens, at Rome.

To that material he added observations from his own dissecting table where he worked endless hours apparently without ever growing weary. He upset—with relish no doubt, and not at all diplomatically—many of the ancient beliefs of how the human body works. One of his outstanding contributions was his discovery that blood, not air—as men had been wont to believe—filled the arteries. Another was his announcement of the purpose of the kidneys and how they fulfilled that purpose. As a firm believer in one God as the creator of the universe, he took upon himself the great task of

proving that the organs within our bodies are perfectly planned not only for each one's own particular work but for cooperating with all the other organs, thus making a smooth running system to carry on the life of the human race.

But when the Goths and Vandals descended on Rome with all their destructive force, Galen's fierce defense of his beliefs was swept into the dimness of the Dark Ages along with the rest of the glory of those proud Seven Hills. For centuries, confusion and terror choked almost all desire for learning. The wonder is that man ever found his best self again after such a submerging by destructive forces. The greater wonder is that anything worth while survived. But some things very much worth while did survive. In the world of medicine some progress was even made. Hospitals grew better. A few good physicians also loomed up above the dealers in magic who preyed upon the sick. On the whole, however, Chaucer, in his cross section of life in the *Canterbury Tales*, gives the following fair picture of what man might expect when, as late as the fourteenth century, he turned to a physician for care:

> For he was grounded in Astronomy
> He often kept a patient from the pall,
> By horoscope and magic natural.*

* From Geoffrey Chaucer's *Canterbury Tales*. Rendered into English by I. W. Nicolson, Covici Friede, Inc., New York.

As the brilliancy of the Renaissance, however, flared out over Europe, as printing was invented, as the daring of explorers extended men's vision of the world's boundaries, medicine, as all science, took stock of its past, present, and possible future. Men turned eagerly here, there, and everywhere to follow a master—turned from their own field of thought and study into that of others.

There was Leonardo da Vinci, for example, that great artist of the courts of the Florentine Medici, who, in order to reproduce the human body accurately, mastered the study of anatomy and physiology. Mastered it so thoroughly that Andreas Vesalius, born only four years before da Vinci's death, and sharing with Herophilus of early centuries the title of Father of Anatomy, turned to him as an authority in writing a textbook on that subject.

In the meantime, through those Dark Ages, a nation had grown up on an island which the Angles and Saxons called England, an island far off to the north, under misty skies, where men had had to sharpen their wits to meet problems of living unknown in the warmer, southern lands. Since this nation did live on an island, the Renaissance following the Dark Ages was later in having its full effect on life there than on the mainland. Nevertheless, by the last of the sixteenth century, a court of men was surrounding the English Queen

Elizabeth with a learning somewhat different in type, but no less brilliant than that of Athens, Alexandria, and Rome.

But it was in 1616, thirteen years after Elizabeth's death had marked the end of the Tudor reign and the crowning of James I had begun that of the Stuarts, that William Harvey strode into the midst of England's learned circle to announce his theory of the circulation of the blood. How any man during those years in England could find a spot quiet enough, peaceful enough, to do a piece of constructive work is a wonder to this day. How he, while befriending the gay, irresponsible Stuarts, could still find enough hours of uninterrupted quiet to concentrate on the intricate passage of the blood through the human body and for the first time bring to the human race the story of that passage—is beyond the understanding of any ordinary mind.

Thomas Sydenham

But even more difficult to grasp is how any man serving on the Puritan side of that century's struggle could have kept within him any regard for the value of human life. Oliver Cromwell fed men to his wars as a farmer feeds grain to his threshing machine. Nevertheless, Thomas Sydenham, born just a year before Charles I came to the throne in 1625, was a Puritan who served under Cromwell and yet found his desire to conserve human life grow with his years. Perhaps the tragic waste of war made him all the more determined to do what he

could to combat the waste of human beings through disease.

At any rate, something concerning medicine which he happened to overhear from the physician attending his soldier brother immediately threw open a new door for young Sydenham. He was then in his early twenties, the son of a country gentleman of Wynford Eagle, Dorset, studying at Oxford. At that time, in the 1640's, Oxford was the very hotbed of the struggle between the Puritans and the Cavaliers. Charles himself was there holding together the remnant of his army and court in the old university town. It is easy to imagine something of the tumult and fury of those days among the students of the different colleges, and to understand why no one of them could avoid taking sides. Especially a Sydenham from old Dorsetshire, a veritable Puritan stronghold.

So Thomas Sydenham, despite any vision he might have had of saving instead of destroying life, went off to fight under Oliver Cromwell. After that he came back to take up his studies at Cambridge, to go to Montpellier for research work, and in 1663 to pass the examination of the College of Physicians and Surgeons, enabling him to practice in London. It was not until thirteen years later that he finally, when he was fifty-two, received his degree in medicine from Cambridge. He lived to be sixty-five, which means that he had only a little over a dozen years to serve his profession. Some measurement of how he served both that profession and

his fellow men may be gathered from his own words when he said

> I have weighed with a nice scrupulous balance whether it be my lot to serve men or be praised by them and I prefer the former.

Like Hippocrates, Sydenham insisted on making his own observations and on basing his conclusions on what he saw rather than on any theory or tradition. Like that man of Cos, he believed that disease had a natural rather than a supernatural cause. But he went further. He began to *differentiate* in diseases. Malaria, smallpox, cholera, and a number of others he diagnosed from a differential standpoint. What caused these diseases, how to treat them, still remained a closed book at the end of Thomas Sydenham's life. Nevertheless, he had done much to "serve men" when he was able to give names to and describe certain symptoms, certain possible effects of different diseases. And because he had, he earned for himself such titles as "the English Hippocrates" and "the founder of modern clinical medicine."

John Hunter

By the end of the sixteen hundreds, therefore, man, through the gifts of medical scientists, was far less at the mercy of disease than in the days when Hippocrates watched the islanders of Cos carrying their sick to the temple of Aesculapius. But even so, ignorance and superstition still tied men's hands. Physicians who spoke

with scientific authority were few and far between. And those who did were heard and heeded chiefly by their own intellectual circles. Even in those circles tradition still blinded men. One Edinburgh physician of the day, popular, demanding a high fee and getting it, prescribed for a sick child "the juice of 20 wood lice squeezed through a muslin bag to be drunk twice a day." If a patient had a felon on his finger he was told it could be cured by sticking the sore finger into the ear of a cat and holding it there for half an hour. It was a common belief, in those days, that fever was the effort of the soul to defend the body against death.

With such confusion still existing among physicians over two thousand years after Hippocrates, with the human body still held by many rulers as too sacred for dissection, surgery lagged far behind even such progress as had been made in the general practice of medicine. On the continent, in the early seventeen hundreds, it is true that there were a few—very few—who are now regarded as scientific surgeons. But throughout the world in general, each village, each rural community depended for surgery as well as for all other relief from disease on some old man who through long years had accumulated a string of charms, of chance cures, an air of mysterious authority, and so had come to be regarded as one who could "cure all."

In no one spot was this more true than in the little country town of Glasgow, absorbed in its weaving of blue and white handkerchiefs to be traded for tobacco

in the strange land of America. Its merchants owned twenty ships. Its streets—some of them at least—were paved. By fast traveling, one could reach London in about a week. That is, he could providing he wanted to ride in a coach swinging precariously over roads scarcely worthy of the name, or across wide stretches of land where there were no roads at all. Between him and London, and in his own town as well, the majority of men and women could neither read nor write. Century after century those same men and women had feared all wild land, all mountainous country, all remote waterfalls, as the habitation of spirits—evil and otherwise. They clung to their traditions, believed in witches, and looked upon all proposed changes with the resentment of superstitious fear.

It was in such a country, several miles south of Glasgow, that John Hunter was born in 1728. His father belonged to an old Ayrshire family. His mother was Agnes Paul of Glasgow. Out from that country family of Scotland was to go William, a son ten years older than John, to attend the University in Glasgow, to study medicine in Edinburgh, and from there to travel that long journey down to London where he was to establish himself as a lecturer at St. George's Hospital. From that same family John was to follow William down to London to become not only that city's most renowned surgeon, but to win fame from the whole world of science as the one who raised surgery in England to the rank of a scientific profession.

No one can explain the mystery of William and John Hunter coming out of that tiny town of Scotland to brave the opposition of their time to all interference with old traditions. But anyone following their life story may know how they arrived where they did in their later years—William to become physician extraordinary to the Queen, John, surgeon extraordinary to the King, while at the same time each piled up contributions to medical science for which every man living today has just cause to be grateful.

John was about twenty before he got off to London, a rather uncouth country boy, who had floundered about at cabinet-making, trying to find where he belonged and what the world had to offer him as the youngest of a family of ten. Whether William was glad to see this young brother or not may be a question. Nevertheless, he made the best of the arrival both for himself and for John. He kept close to the youth for eleven years, most of which time John was working in his brother's dissecting room and helping with demonstrations and experiments. During those years John had also made up his mind to study surgery and had begun with Cheselden and Pott, two of that day's most famous London surgeons.

Now, surgery had taken a mighty stride forward not long before John Hunter reached London. Up until that advance, English surgeons had been known as "Masters or Governors of the Mystery and Commonalty of Barbours and Surgeons in London." But with the science of

medicine coming slowly into its own, scientists declared that barbers should remain barbers, surgeons should become surgeons. So an appeal had been made to Parliament to change the title to "Masters, Governors, and Commonalty of the Art and Science of Surgeons in London." That appeal had been granted in 1745.

With that new title had come new standards of training in surgery. Previously, when a youth wanted to become a surgeon he set out to apprentice himself for three years with some surgeon apothecary in practice. At the end of that term of work he had to appear before the College of Surgeons to dissect a limb, write a thesis, and make up a prescription. At least that had been the training in Scotland, where the separation of surgeons from barbers had come about a number of years before it had in London. Later, when that separation did come in London there came at the same time a dawning distinction between all quacks and men scientifically trained in medicine. To make all such training increasingly thorough a new association of surgeons was formed known today as the Royal College of Surgeons. It was the purpose of this association to accumulate a common fund of knowledge to which all students could contribute and have access.

It was a wonderful time for any youth with such dreams as John Hunter had to find himself in London. Especially to be there in daily association with capable and devoted men, and to lead his chosen profession on to roads of greater scientific development. He made the

most of his chance. Following his work with Cheselden and Pott, he became a surgeon's pupil at St. George's Hospital. Two years later he was appointed house surgeon there. Then he entered Oxford, where he seems to have scorned most of the classical studies. After some time there an attack of lung trouble forced him to seek another climate. Fortunately he was able to get an appointment as staff surgeon with an expedition to Belleisle, where, while serving with the English forces along the Portuguese border, he acquired his wide knowledge of gunshot wounds.

In 1763, when he was thirty-five, he was able to retire from the army on half pay. He returned to London and set himself up as a surgeon in Golden Square but was so poor that he had to supplement his income by teaching practical anatomy and operative surgery to private pupils. Among his students he was later to count Edward Jenner, to whom the world owes a vast debt of gratitude for his discovery of vaccination to prevent smallpox.

In the meantime William had become famous while John was still practically unknown. But John was not made of the stuff to stay so. Working from six in the morning until one or two the next, questioning, answering his own questions by his own first-hand observations, operating, lecturing, studying ceaselessly, he had accumulated enough money to buy himself a home in Golden Square and fame sufficient to be elected a Fellow of the Royal Society three months before his brother William.

He had also acquired enough social distinction to meet Anne Home, daughter of the surgeon of Burgoyne's famous light-horse brigade, whom he married in 1771. Looking back on that marriage, one wonders how the gentle Anne ever managed to live in the house at Earl's Court which John built a year after the wedding and where he spent long months of the autumn busy in biological research with fish, lizards, toads, silkworms, bees, hornets, and wasps. For Anne Home was a poet of note who wrote the words for some of Haydn's lighter compositions, the most famous of which is "My mother bids me bind my hair."

In addition to all the crawling and flying creatures of his laboratory, John's temper made him anything but easy to live with. That temper, a Hunter characteristic shared by William, flared high when each of the brothers claimed credit for a scientific discovery brought about by joint research. The bitterness arising then cut off all association between the two until William sent for John during his—William's—last illness. Even then that call was sent because John was the best in his profession and not, apparently, because of any longing William had to see his brother.

But stormy as John Hunter's nature was, there was a gentleness about him that bound his friends close to him. At the same time honest devotion to his profession brought him, at the death of Percival Pott, unchallenged recognition as the leading surgeon of his country. Fully a dozen years before, he had been made surgeon

extraordinary to the king. By guarding jealously every minute of his day, by demanding from himself never-ending, painstaking work, he piled up a splendid inheritance for those who came after him. Not only an inheritance in surgery, which he lifted in England almost single-handed out of its low and unscientific state to a level from which it could rise to its present-day height, but also in a greater understanding of the structure and functions of the human body. He announced that the body had power to digest tissues no longer useful or needed. He established physiological proof of the muscular formation of the arteries and iris of the eye. He announced that the red blood corpuscles were related to the strength of the body and that the blood had an ultimate standard of heat which nothing except some widely spread bodily attack could increase. He also discovered that the body was supplied with different kinds of nerves.

Honors were heaped upon him during his later years, honors that demanded from him much in return. Sir Joshua Reynolds, attempting to paint his portrait, found him so restless that he could get nowhere with the painting until, one day, some problem fixed Hunter's mind, and the artist caught him with the expression his students were most familiar with and loved best. He had problems enough to keep his mind occupied, and also to add to his natural irritability. As a result his bursts of temper became more violent; so violent that one day when attending a board meeting he flew into

a fit of rage which brought on a heart attack causing his immediate death.

At first his friends laid him to rest in sunny old St. Martin's-in-the-Fields. But half a century later, after the scientific world had had time to measure something of his contributions to it, and after the world of men outside of science had begun to reap benefits from his service to them, England brought John Hunter's body to lie among those she most highly honors in Westminster Abbey.

By the time John Hunter had received that honor much of the fear of the supernatural—black, superstitious fear, halting all reasonable care of the sick—had largely given way before the proof that all disease had a natural cause and therefore could be treated with natural remedies. Surgery was no longer a function of the barber. Quackery had been exposed. Many different diseases had been diagnosed. The structure and functions of the human body still awed men both within and without laboratories; awed them not so much because of ignorance but rather because of the marvels revealed through knowledge of its intricate and delicate machinery of living. By the end of the seventeen hundreds, therefore, the era of what is called diagnostic and curative medicine was well on its way.

II. *Control and Prevention of Disease.*

EVEN so—even if a number of diseases were known by name, even if through a chance system of trial and error certain treatments had been discovered to be beneficial in certain diseases—medical science at the beginning of the eighteen hundreds was far from knowing what to prescribe in all cases. It was still further from knowing what caused most diseases. Contagion swept on, taking its ghastly toll of life with no real defensive measures to oppose it. But because men of science had labored through nineteen centuries, much that had cluttered the way to advance had been cleared. Somewhat freed from earlier hindrances, medical science, therefore, began to look up and out, to ask many questions which it had not dreamed of asking before. If diseases were due to natural, not supernatural, causes, why could those causes not be found? If found, was there a chance of preventing their attacks? At any rate, wouldn't there be a chance of treating the disease resulting from each more surely if the cause were known?

The answers to these queries were not to be made by one man or by one country, any more than the answers to earlier questions in medical science had been made by one man from Cos, from Rome, from the British

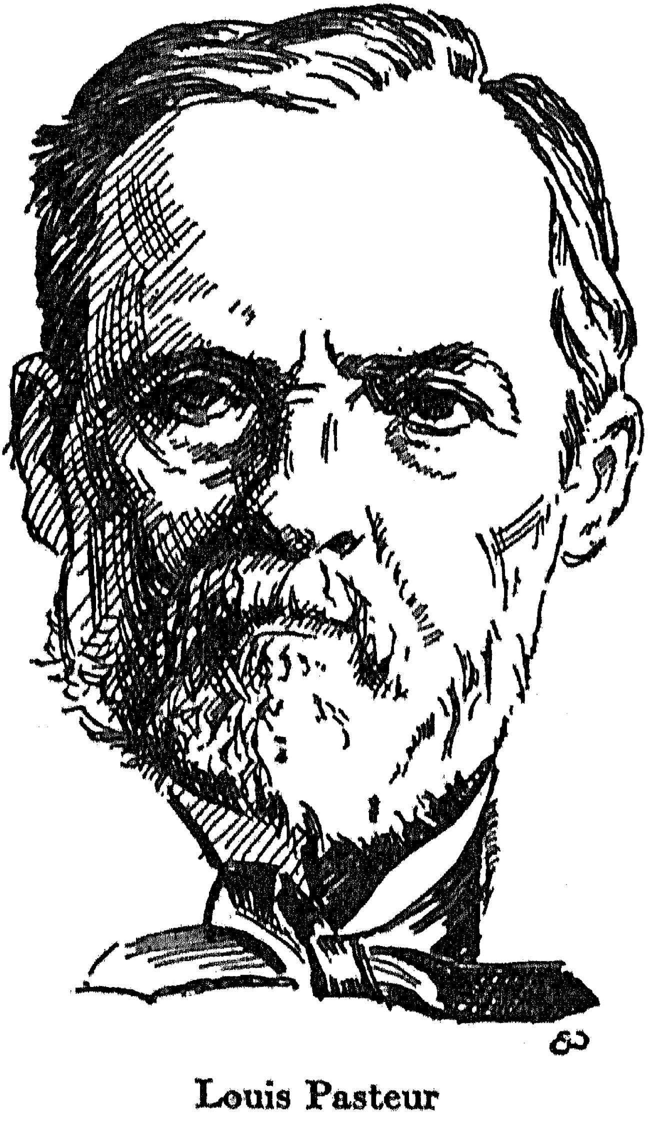
Empire; or any land, no matter how civilized. Neither were they to be made at any one time. There was, for example, Anton van Leeuwenhoek, an eagerly curious Dutch lens-maker of the seventeenth century, peering through the microscope he had just perfected at a smear of blood, at a daub of yeast, and then transferring what he saw to descriptions and drawings easy for the human eye to see. By 1674, this man of Delft, Holland, not scientifically trained in the field of medicine, interested primarily in making better lenses, gave the world its first accurate details of the structure of red blood corpuscles. Nine years later the same man made the first drawing of bacteria accepted as worthy to be included in the Philosophical Transactions of the Royal Society.

And that had all been achieved a hundred years before John Hunter spent long hours of the day and night with his frogs, his lizards, and his bees at Earl's Court. Then there had been that student of John Hunter's, that young Englishman named Edward Jenner, who, greatly disturbed over the helplessness of science to check epidemics of smallpox, noted that certain milkmaids rarely had the disease even when others with them were contracting it. By close observation he discovered that those who were immune had had, at some time or other, a breaking out on their skins following their work among herds suffering from cowpox. Where those who had so suffered could remember the circumstances leading up to their attack, invariably

they disclosed that the trouble had begun in a slight scratch or cut in that part of the skin which had come in contact with the diseased animal. Those declarations led Jenner to the experiments which resulted in his discovering that vaccination would prevent smallpox.

Louis Pasteur

But in the meantime, while the Hunters were bending over their dissections, while they were scientifically noting their conclusions, while Jenner's work was being tried and tested—fearfully—France had struggled through her nightmare of revolution and a young man from Corsica named Napoleon Bonaparte had arrived to lead the nation out of its self-destroying slaughter. Among the Frenchmen who went forth to serve under the great Napoleon was Jean Joseph Pasteur, son of a serf who had bought his freedom with his own earnings. Later Jean Joseph returned wearing across his broad chest the ribbon of the Legion of Honor for brave service and carrying in his heart visions of other services which he and his might be able to render France. What those services might be he had as yet no notion. Until he had, he set about his work as a tanner just as his father and his father's father before him had done. While doing that, however, he looked across the river and saw Jeanne Roqui, modest but vivid, laughing, generous-hearted, working in her father's garden. She was just what he needed to help those dreams of his



Louis Pasteur

come true. So he crossed the river, married her, and brought her back to his tannery.

Some time after that, the young family moved to Dôle, not far from the mountain boundary of Switzerland. And it was there, two days after Christmas, 1822, that Louis Pasteur was born, whom, three score years later, the mayor of Dôle was to proclaim as the greatest scientist of his century. But Louis Pasteur knew on that later day, just as he had known through all the years between, that whatever he had become he owed in large part to the vision of his father and the never-ending enthusiasm of his mother.

Because they did have those qualities, Louis Pasteur's parents early discovered in their small son something different, something which they were sure was to prove of precious value to the world. When he was five they moved to Arbois, still in the province of Jura, where he had been born. There he sniffed the pits where his father soaked hides for his tannery. There he played, went fishing, and very likely seemed to the neighbors to be much the same as any other small boy. Even when he started to school in the primary department connected with the College of Arbois he did not show any unusual ability. Nevertheless, his father saw something more in him than he saw in other boys. So, uneducated as Jean Joseph Pasteur was, he began to study, to study hard, in order to help his small son. Some time, he dreamed, that son might even be a professor in his town college.

That dream grew when Louis entered college and showed enough of his mother's vivid imagination, enough of the slow careful thinking of his father to cause the headmaster to ask him whether he had ever thought of going on to the famous École Normale in Paris. Arbois was a long way from Paris in those days. The École Normale was even farther away from the tannery of Jean Joseph Pasteur. Nevertheless, if his son showed enough promise to be asked such a question, Pasteur intended to do his share in helping to fulfill that promise. He began to work harder than ever, to save, to plan. So well did he do all three that one dreary, rainy day, Louis Pasteur, then only fifteen, found himself bumping along the road to Paris, miserably homesick, on his way to enter preparatory school for the great École Normale. The dreams of Jean and Jeanne Pasteur certainly seemed to be coming true. Back in Arbois they kept right on working, kept right on saving and planning, kept right on rejoicing proudly that a son of theirs should be on his way to enter the world of great learning.

And while they did, that son kept right on being homesick. He couldn't sleep. He couldn't eat. He cried out

> If I could only catch a whiff of the tannery, I should be cured!

But long, long miles lay between him and those pits where the hides soaked in amber water. So long that

Louis, thinking of that distance between him and his home, became ill. The headmaster, alarmed, sent for Jean Joseph Pasteur. And Jean came to sit dejected, bitterly disappointed, with his head buried in his hands waiting for Louis to get his belongings together. Then the two rode back to Arbois.

Fortunately for Jean and Jeanne Pasteur, and even more for the whole world, Louis Pasteur was not the sort to yield to one defeat. Besides, there was Besançon, barely thirty miles from Arbois, where he could study for the École Normale and still get back now and then for his "whiff of the tannery." So he went to Besançon, and stayed. He made friends that he was to keep all his life. He won the respect of others for his exquisite thoroughness. In the end he was handed his diploma.

That behind him, he returned to the school at Paris, this time to stay. After a year, when he was twenty-one, standing fourth on the list in his examination, he finally entered the long-dreamed-of École Normale. The first stretch along the shining road of his father's and mother's dreams had been covered. After that, he was to travel swiftly, always forward. Entering the classes of the great scientist, J. B. Dumas, he was immediately swept along by an overwhelming interest in the study of chemistry. He spent hours without end in his laboratory. He had to be dragged out of it to sleep and eat.

It was such work that enabled Louis Pasteur to pass an examination in his third year at the École Normale,

permitting him to teach there. It was also that work which caused the famous chemist, Balard, to take the young man into his laboratory, where he could best continue his study of the forms and nature of crystals. That study had already held Louis Pasteur spellbound for several years. It was in Balard's laboratory that he completed his research and made his announcement concerning his conclusions. He was then twenty-six. Straightway he became the most talked-of young scientist in Paris.

None of this meant anything to Louis Pasteur in face of the word that came to him from home. His mother, Jeanne Pasteur, was dead. He could think of nothing except getting back to Arbois where he could sit with his father and wander around the familiar country. Weeks later he came back to his work, first as professor of physics at Dijon and then, a year later, as professor of chemistry at Strasbourg. It was at Strasbourg that he met the daughter of the university rector, married her, and began that rare companionship which was to inspire and steady him all his life.

Five years after he began his work at Strasbourg, France turned to Louis Pasteur to rescue her wine industry from the disease that had for years been reducing her income. Appointed professor and dean of sciences at Lille, the center of the wine-producing district, he found himself plunged into the problem which was to absorb him for the greater part of ten years. He examined the sick wines under his microscope.

He found not only the little yeast plants necessary for fermentation but also other tiny rod-shaped bodies which had no business there. He examined the healthy wine and found no rod-shaped bodies. He poked here and there among the wine vats. And then he finally announced:

> Keep those rod-shaped bodies from your wine and all will be well. They enter from the air. But if they do succeed in getting in, heat your wine to the temperature I indicate and you can kill them.

The merchants did as he said and their wine grew healthy and valuable again. But when Louis Pasteur turned to the world in general to ask,

> If living organisms cause diseases in wines, why may they not be responsible for contagious diseases among men and animals?

many men scoffed and would have none of his theory. Others halted long enough to wonder over it. A few accepted it. With those few, led chiefly by Louis Pasteur, medical science began to swing out into the hope of a second great advance in the world's fight against disease; an advance which as the years passed was to reduce the menace of contagious diseases, through finding and waging war against the particular germ causing each.

All this is why Louis Pasteur, ten years after he first peered down into the dark depths of Lille's wine vats, found himself being hailed not only as the leading

chemist of his time in the world of science, but as a benefactor to all the world, beset by fears of epidemics and plagues since its beginning. Honors were now again heaped upon him; this time not only by his own field of science, not only by Paris, but by men of all classes and countries.

In the midst of this acclaim, France again called him to save one of her most valuable sources of income—the raising of silkworms from cocoons. For over a score of years disease had been attacking all stages of the silkworm's growth. Could Pasteur help here as he had in the wine industry? In 1865, he consented to try. Two years later, he announced that he had found the cause. Six years later, the silkworm industry of France was again on its feet with the disease under control.

Those were years of great scientific conquests for Louis Pasteur; but, at the same time, years of great personal grief over the death of his father, and of his two little girls—the three within a year. Also years in which he himself had suffered a stroke of paralysis which left him greatly handicapped and kept him from fighting for France in the Franco-Prussian War. Sick in body and mind, in 1870 he went back to Arbois. Three years later, however, he was again in Paris attending a meeting of the Academy of Medicine, to which he had recently been elected. The next year, France voted him a yearly income of 12,000 francs for the rest of his life in return for the services he had already rendered her and all mankind.

Financially secure, but with his crippled leg still bothering him, he now turned his whole attention for a time to conquering anthrax, a disease ravaging the cattle of France as the wine and silkworms of that country had been ravaged earlier. The herds and flocks of all Europe had been suffering for years from this disease. Scientists everywhere had long been puzzling their heads over how to get control of it. Puzzling them to some purpose, for by the time Pasteur turned his attention to it, Davaine, a Frenchman like himself, had announced the discovery of microscopic rodlike bacteria as the cause of the disease. Robert Koch, a German, had then added to Davaine's discovery his finding that these bacteria had the power to form spores —tiny round bodies protected by thick walls—which could and did lie undeveloped until conditions in their surroundings brought them to life and to production of their kind in an amazingly swift and destructive fashion.

Pasteur, of course, accepted what Koch and Davaine announced. But to know the cause was one thing; to prevent the development and spread of the disease arising from that cause was another. About this time, however, Pasteur was also interested in getting control of cholera, which was killing about ninety out of every hundred chickens in France. In experimenting, he discovered that by inoculating the fowls with a weakened chicken-cholera virus they became immune to the deadly disease. Since this method of protection was exactly what Edward Jenner had discovered as working

successfully in connection with the spread of smallpox, no one claims that Pasteur was presenting a new theory in his announcement concerning the control of chicken cholera. But he had made the idea clearer by his explanation of how the body in its fight against the weakened virus, which he used for inoculation, gains strength to protect itself against the fully live germs of the disease. Further, he had proved that the virus could always be weakened by surrounding it with conditions unfavorable to its growth.

Armed with this new light, Pasteur now claimed that anthrax in cattle could be controlled in the same way—by vaccinating them with a weakened virus from a diseased animal. That claim was immediately challenged. Pasteur as immediately accepted the challenge. He selected fifty sheep and divided them into flocks of twenty-five each. The first twenty-five were vaccinated and then later inoculated with fresh virus from anthrax-infected sheep. The other twenty-five were not vaccinated but were inoculated with the fresh virus. The fresh virus was given to both flocks on the same day. Great crowds gathered to see the result. Many had not a doubt but what Pasteur would lose. However, within the time set by him after the last inoculation, every one of the first flock—the flock that had been vaccinated and then inoculated with fresh virus—was alive. Every one of the second flock was dead. And the dreaded disease of anthrax was on its way to being controlled.

In gratitude, the French government offered Louis Pasteur the Grand Cross of the Legion of Honor. He would take it only after the government had offered it also to the two loyal young assistants who had helped him with the experiment. His pension was raised to 25,000 francs. When, not long after the anthrax experiment, he entered the hall of the International Medical Congress in London, the whole great audience began such a storm of applause that he peered about, curiously, thinking that no one less than the Prince of Wales could have aroused the cheering.

And he still had more to offer. For years, he had been studying hydrophobia and had become convinced that the poison attacked the nervous system. He now decided to inject nerve matter from a rabid dog into the brain of a well dog. But he was so fond of dogs, so tender-hearted where they were concerned, that he could not bring himself to make the injection. One day when he was out, one of his assistants made it for him. On his return Pasteur was plunged into pity for the animal, for, as he dejectedly said, he knew the dog would be mad by the time another two weeks rolled around. His prophecy proved true. Further trials led him to make a weakened form of the bacillus which he hoped could be used for human inoculation. On July 6, 1885, he made his first trial with this on little nine-year-old Joseph Meister, who had been bitten by a mad dog. Then, having tried it, he walked the floor night after night for fear the child might die. Joseph, however,

not only lived but lived to contribute gratefully to the building of the Pasteur Institute, where thousands of those threatened with hydrophobia have been treated and where not one out of ten has died.

Louis Pasteur lived on ten years after he and small Joseph had made this contribution to man's greater safety. When he was seventy, France invited scientists from all over the world to gather in a celebration to honor him. When the President of the French Republic entered with Pasteur on his arm while a famous band played a march of triumph, the whole audience rose to its feet as one man, to greet him. After that he kept on working, hoping to complete before he died his experiments for the control of diphtheria.

But his tired body rebelled. He went away, hoping to rest that body and regain some of his old-time vigor. But he had made too many demands on his strength for any reserve to be left on which to build. Gradually he grew weaker. The end came in September—September 28, 1895. Madame Pasteur was with him. So was his priest. So were some of his many, many friends who like those of his early schooldays had come to love him for his gentle, modest spirit, his never-failing kindliness. Outside, the whole world of science waited his passing with bowed heads. But what would have most pleased the soul of Louis Pasteur in those last days was the honest grief of men whose fears he had quieted, whose sufferings he had lessened, for whom he had spent without stint those gifts which he considered his only in

trust for such service as he could render his fellow men. And as the years pass, both men of science and plain men of everyday living pay growing reverence to Louis Pasteur as the man to whom, more than any other, the world owes a vast debt of gratitude for freeing it from the devastating ravages of infectious and contagious disease.

Joseph Lister

Fortunately for those among the world's sufferers who are forced to submit their chances of recovery to the surgeon, the nineteenth century was also to see a significant decrease in the dangers resulting from operations. That decrease science attributes chiefly to the work of Joseph Lister, born in England only five years after Louis Pasteur began life in his father's tannery in France.

Fortunately for the whole human race, Joseph Lister was born of parents who believed, much as Jean and Jeanne Pasteur believed, that life is a gift—a gift of God to be used in trust for the greater happiness of all men. That one fundamental likeness, however, was about the only similarity that can be traced between the French tanner of Dôle and the Quaker English wine merchant of London. Where the former had to labor hard to help his small son in his first studies, the latter knew his classics so well that he could pass upon his children's reading of Latin while dressing for the day. Where the former had little leisure from his work with

hides, the latter had enough outside his day's work to spend hours in his laboratory, where he discovered important equations which later led to the production of the achromatic lens. He had time to become a skillful artist. His wife, a beautiful woman of culture, while of strong character, does not seem to have influenced her son as much as his father did.

Although the home of those Quaker English people was one of peace, it demanded that the six children growing up there attend strictly to the business of getting ready for responsible living. Roaming through the forests and marshes close to their home near London, they found never-ending delight in their studies of natural history. Joseph began very early to dissect small animals, then to study the human skeleton. He wrote of what he studied and made exquisitely accurate pen-and-ink drawings to illustrate his pages of careful writing. All this greatly pleased his father.

But when that son announced one day that he wanted to be a surgeon—well, that was another matter. No Lister had ever been a professional man. Certainly no one of them had ever thought of becoming a surgeon. But nearly a hundred years had passed since John Hunter had come down from Scotland to aid Cheselden and Pott in giving the surgeon's knife a skill apart from that of the barber's razor. Surgeons were even beginning to be looked upon as gentlemen. Maybe, after all, young Joseph knew what he was about. Certainly the boy thought he did and he meant to stick to his decision.

Joseph Lister

Not only meant to, but did throughout three years of working for his B.A. at the University of London and throughout a long delay caused by an attack of smallpox followed by a complete nervous breakdown. In the end he won out. And then began his long years of preparation for surgery.

Years in which he was to see the use of anesthetics in the operating room relieve the shock, the agony of the patients there, but years, also, in which he was to see an astounding loss of life from blood poisoning during the days of postoperative convalescence. Sometimes whole wards were closed because of the great number of deaths resulting from what, as he thought, should have been successful operations. From those wards he turned back to the small theater of the University College Hospital to gaze down into the pit where one small operating table stood under one sputtering gas flame, where there was never more than one wash basin to be used by surgeon and assistants, where there was only one instrument cupboard and that not overly well equipped. Did that limited and unsanitary equipment have anything to do with the patient's desperate and often losing fight for life?

Joseph Lister was still asking that question when he went to the University of Edinburgh. He was then twenty-six. He stayed in Edinburgh seven years. He became closely associated with Dr. Symes, one of the outstanding surgeons of his day, and later married his daughter. He taught. He operated publicly. And he

worked far into the night on the problem of inflammation and coagulation of the blood while his wife worked with him, sharing his observations and taking dictation about his conclusions.

At the end of those seven years he went on to the University of Glasgow, where his opportunities as professor of surgery were greater than in Edinburgh. A year later, he was appointed surgeon to the Royal Infirmary. But as his opportunities grew so did his responsibilities. In Glasgow—and not only there but in all cities—fully one fourth of the operative cases died. Surgeons looked on practically helpless, fighting in the dark for the cause. Usually they blamed the air as being polluted. They had heard of microbes but they still considered them more as curiosities than as actually existing to be fought by science. Their lack of cleanliness is unbelievable in the present light of scientific knowledge. When the house surgeon entered the operating room he donned an old coat, often stiff with filth accumulated through months of operating. Usually there dangled from the pocket of that coat a piece of whipcord conveniently ready for tying the severed arteries. Nurses came directly into the operating room from assisting in post-mortems or from attending erysipelas, septicemia, tetanus, or gangrene cases.

Joseph Lister, standing in the midst of all this, burdened with his boyhood ideal of using whatever gifts he had to relieve human suffering, operating, teaching his large and enthusiastic classes, finally

lifted his head, along about 1865, to hear the voice of Louis Pasteur ringing out over the world in the assertion that putrefaction was a kind of fermentation caused by microscopic beings floating in the air, and that it was possible to purify that air by filtration, by heat, or by other means. If that were true, then all one had to do to insure the successful treatment of a wound was to prevent the air from even striking its surface.

Lister decided to heed Pasteur. Accordingly he applied carbolic acid to a wound until it mingled with the blood to form a thick crust. That crust he painted daily with the acid until all danger of infection was past. His first attempt was a failure. He tried again. And again. He modified the severity of the acid application. He found he was improving his treatment. But he kept on until he felt he was justified in announcing the results. That announcement came in an 1867 issue of the *Lancet*. Over on the continent, in Denmark, Sweden, and Germany, the value of his experiments was not questioned. But in his own land, especially in London and among older surgeons, his assertions were not only questioned, but scoffed at and ignored. Even where the treatments were tried, they were tried halfheartedly so that the results were unsatisfactory. Nevertheless, although sharply hurt, Joseph Lister kept right on working. Among other things, he attacked that piece of dirty whipcord. He substituted for it one antiseptic agent after another until he found one to serve satisfactorily.

At the death of his father-in-law, Dr. Symes, he moved back to Edinburgh and took the chair of clinical surgery at the University. He remained there for another seven years, before accepting gladly the chair of clinical surgery in King's College, London. Perhaps, he thought, if the surgeons there could see what he was really doing they would be more sympathetic toward his work. But the staff at the hospital were not at all friendly. They blocked his directions whenever they dared. If he had not taken with him four of his best men from Edinburgh, he might not have won out.

But he did win out, gradually. Won out to have honors showered upon him; to become Surgeon in Ordinary to Queen Victoria; to be raised to the peerage; to be made the directing influence of distinguished societies within his own profession; to be recognized both at home and abroad as the man who had done much to banish forever many of the dangers threatening recovery from surgical operations and as one who had contributed new triumphs in surgery both through performing difficult operations successfully and through inventing instruments which aided in swiftness and sureness.

At sixty-five, the age for retiring from King's College, he was asked to stay on for another year. During that year, his wife, always his companion then as in those days of his early experiments, while tending some specimens the two had gathered on the Italian Riviera,

was taken with a chill. Four days later she died from acute pneumonia. They had shared life for thirty-seven years. Long before that his lovely mother had gone. Then his father. Now, lonely and desolate, he lived on through a dozen years. He occupied himself with his hobby of field botany. He watched with intense satisfaction all advance in the medical profession. And he attributed all success in that profession to the two requisites he had always insisted his students should have: "First, a warm loving heart; and, secondly, Truth in an earnest spirit."

Auguste Rollier

But does truth always remain the same truth under all skies? That is what was puzzling small Auguste Rollier along Lake Neuchâtel in sunny Switzerland, at the very time Joseph Lister was trying to convert foggy London to his way of thinking. It was all very confusing. Especially to a boy who had dreams of being a great surgeon himself some day. Already he had studied enough to operate on his pet spaniel for a tumor on the spine. Already he knew enough to protect the wound by very elaborate dressings. Despite all his skill, however, the minute he turned his back the dog clawed off the bandages and stretched himself out where the sun could pour its rays directly into the wound. Of course the little beast should, according to all newly discovered principles, be suffering from blood poison. But he was not doing anything of the sort.

Instead, the wound was healing most healthily. Why? The boy wrinkled his forehead, pondered, and then stowed the question away in his mind, with scores of others for later answering.

After that he turned his eyes to his sturdy brown schoolmates racing down from the mountainsides, and then back to himself. White-skinned, frail, the son of a book-loving professor, although he had a superior knowledge of history and science, he had to take a licking from those country-bred fellows whenever they staged a fight. They lived out in the open, tending the family flocks and herds, working small fields, climbing steep paths through long days under sunny skies. Their bodies were hard as iron; his was flabby and soft. Well, if the sun of Switzerland could heal his spaniel's deep wound, if it could make and keep other boys fit enough to lick him to a finish, he would try it. So he began to bathe in the sun. And to find his own strength growing, his own powers of resistance developing, his own skill in handling his body measuring up to that of his schoolmates.

Then he went to study with the famous Dr. Kocher, a surgeon whose skill in operating was equaled by his skill in protecting operative wounds from septic poison. But learned as that great man was, he had one group of baffling patients. That group was made up of those afflicted with tuberculosis of the bones. While working side by side with Dr. Kocher through four years, Auguste Rollier saw fifty out of every hundred of that

group leave the operating room to die. He saw his own best boyhood friend come in to have his hip, his shoulder, operated on, to lose a finger, then a foot, and, in the end, to go out and take his life because he had lost hope of ever being well again. As he watched that tragedy, and as he watched scores of others, Auguste Rollier decided that tuberculosis of the bones called for some treatment other than surgery.

About this time his world went topsy-turvy when his sweetheart developed tuberculosis of the lungs. She was ordered to go up into the mountains if she wanted to live. Immediately, Auguste Rollier, already showing promise of a brilliant future as a surgeon, turned his back on that promise, to follow the girl and to begin his career as a country doctor among the mountain peasants around Leysin. He did everything such work demanded. He brought babies into the world. He treated old men and women whose bodies had grown gnarled and bent through following their nimble cows along steep mountain paths. He operated when some one of those neighbors lost his footing and was found hours later lying maimed and groaning at the foot of a cliff. He operated grimly in dim little huts, where he could hear the cows stamping in the stable end of the mountain home. He operated with smoke from the fireplace filling the room. And returned, just as grimly, fully expecting to find the wound festering with poison only to find it healing as healthily as that of his spaniel had done years before.

As in those earlier years, he now turned from peering at those wounds to gaze out into the sun-filled air about him. All around him were snow-capped peaks, for Leysin stands a mile high among the Swiss Alps. Above him was a sky rarely clouded. Even winter storms sweep down and away from those slopes swiftly. Peasants hang their meat out in the open to be cured, sure that the air's purity is their best protection from any loss. Auguste Rollier, seeing all that, remembering all he had observed as a boy, as a youth, as a student, then linking the whole story together, stopped to consider.

As he considered he heard of Bernhard, Bernhard of Samaden, living just across the mountains. Bernhard, who, listening to his peasant friends crying out rather tauntingly, "Where the sun is, the doctor ain't," had been impatient with them at first, but later had come to acknowledge there was much wisdom in the saying. To acknowledge and tell the world how his mountain people could and did grow old in years and yet remain amazingly young in strength and vigor, all because of the long, long hours they spent out under the sun on their warm slopes.

In the meantime, while Rollier had been tending his sick peasants, while he had been observing the wisdom of their living close to "old Doc Sun," his sweetheart had been growing better. If the Swiss Alps did that for her, why leave them? So the two decided to be married and live on in Leysin. Having so decided, Rollier, no longer quite content, perhaps, to spend his time with

people who after all could get along most of the time very well without him, concluded now, if ever, was the time for him to set up a clinic for that group of miserable human beings afflicted with tuberculosis of the bones.

And in that decision Auguste Rollier showed he had found his answer to the question of why unprotected wounds—in his spaniel or among the peasants of his practice—*should* heal, free from poison, in his mountain country, although the same wounds left exposed to the filth-laden air of London would demand every possible protection prescribed by Joseph Lister to keep them from developing septic poison. The answer was in the air of his Alps, in the sun's rays which shone directly down into open wounds without first traveling through layer after layer of pollution as they did in cities of lower lands.

That settled, he selected his site, about five miles from Leysin. He established his clinic in 1903. Straightway there began a most astonishing ascent up the mountainside. An ascent of crippled, white-faced children, of men and women on crutches, of human beings twisted with disease until shame in their own deformity equaled their bodily suffering. Reaching the clinic, they were immediately put to bed in great airy rooms where windows looked out upon snowy peaks cutting into a sky whose blue was drenched with sunshine. Later, they were moved to balconies. And there, gradually, very gradually, their bandages were removed so that the clean, unpolluted air could enter the open sores and

wounds, and then so that the sun could beat down directly into them. Still later, bare feet were exposed to that sun for a few minutes. Following that, the whole body was slowly, day by day, uncovered until the patient lay entirely naked under the warm rays. White skins turned to soft tan. As they did so pain grew less.

Weeks passed. Then months. Pale-faced youngsters who had not smiled for years began to smile eagerly. Thin, pathetically thin, bodies grew round and plump. Within three years, five-year-olds who had been given up by surgeons down in the valleys were skiing across winter snow, tossing balls out under summer skies, stripped to the skin so that the sun could have its full way with them. As years passed, Auguste Rollier had the joy of seeing an average of ninety out of each hundred of those who came to him crippled walk down that slope from Leysin, erect, strong, able to take their places in the world once more.

Seven years after that first pain-stricken group found its way to Leysin, there began a pilgrimage of those who hoped that by coming early enough the sun might halt the devastating work of the tuberculosis bacillus before it fully developed. They received the same treatment as those of the first parade. The results were most reassuring. Out of a group of a little less than five hundred, two died, one remained frail, one had to return for treatment but later with the remaining hundreds went forth healed and free from fear.

But tuberculosis of the bones is a stubborn enemy. To rid one's self of it takes months, sometimes years, from active life. In the meantime children grow up; men and women often have to leave the burden of family support to others. Frequently the mental worry of being a financial burden, the weariness of just putting in the time while waiting to get better, are enough to interfere seriously with recovery. Dr. Rollier was not long in seeing this, not long in recognizing that some sort of work adapted to the patient's strength was quite as necessary to that patient's mental and emotional well-being as the sun was to his physical well-being.

The Work Cure was therefore instituted in his clinics. Today, anyone visiting there may see whole groups of unclothed youngsters picking up their portable desks and striking out for their school in the sun—some sheltered place where they carry on their studies apparently as oblivious to the entrancing pictures about them as if they were shut in by ordinary walls of a schoolroom. Along the balconies where the bed-ridden are bathing in the sun, all sorts of work is being done. Beds are fitted out with complete work benches. Modern electrical contrivances are attached to convenient plugs. Out in the fields those who are further along in recovery work for as long hours as their condition warrants. In 1930, the International Factory Clinic of Leysin was opened. Today markets are arranged in the outside world. Money is earned. Creative

ability is encouraged. In short, long empty days are turned into days full of purposeful living so that when a patient finally leaves Leysin, he may leave it to take up life again better equipped physically, mentally, occupationally, than when he entered.

Despite this practical service to his patients and the world at large, despite the proof which was constantly taken down that mountainside by those cured, Dr. Rollier's work, like the work of other scientists who have introduced new theories, new practices, was not welcomed by the outside world in his early years at Leysin. In fact, when he appeared before a group of scientists in Paris two years after opening his clinic, the audience—the entire body—got up and went out, leaving him standing alone. No one, those wise men said, could measure his remedy—sunshine—in a laboratory test tube. They would have none of him.

But later there was Bernhard confirming Rollier's statements concerning the healing qualities of the sun's rays by exposing the ghastly wounds of German soldiers to the same healing treatment and finding those soldiers reacting in greater strength of body and courage of heart. There was also Finsen, the great Dane, claiming so much for his sun lamp. There was that other Dane, Thorvald Madsen, carrying his observations into the fields of treatment for diphtheria, tonsillitis, and bronchopneumonia and announcing that since the death rate from those diseases was higher from November to March, and lower through July and August, it

was but natural to conclude that the hours of sunshine of the summer months formed an almost invulnerable defense against them.

With such backing from his own profession, with the rapidly mounting testimony of those whom he had cured, Auguste Rollier broke down the early skepticism regarding his work. Today, vigorous, still young enough to count on years of promise, he looks out through the clear, sunlit air of his Swiss Alps, a modest man of rugged strength, of unending kindness, who counts his days as worthily spent if he can give back the hope of life, the strength to live it, the joy of work and achievement to those who turn to him in suffering and in fear.

No one can claim that this era of prevention has even now reached the peak of its development. No one can claim that prevention has taken the place of cure in the progress of medicine. Each works for the greater safety of man's life. One service, however, that this age of prevention can make just claims to having developed largely by itself is that of cooperation between the lay public and the medical world for the protection of public health. To support that cooperation a whole host of engineers, chemists, physicists, specially trained nurses, nutrition experts appeared. Laws were made to enforce the principles laid down by them. People everywhere had to be sufficiently informed of those principles to obey the laws intelligently. Out of these

demands, departments of public health came into being under town, state, and government direction.

All this is taken as a matter of course today in every civilized community. So much so that few stop to consider all the centuries of progress there have been leading up to our own, where each family, each individual, regardless of race, of class, of money or lack of money, may have equal protection against contagion or infection under the laws of his land. Few think in gratitude of Edward Jenner's long struggle for recognition in connection with his theory of vaccination as a protection against smallpox, or of the scorn Joseph Lister met in his work against septic poison. There are more who realize their debt to Louis Pasteur. There are those who will always return grateful thanks for the work of Robert Koch, the German bacteriologist, who, after aiding in the conquest of anthrax, went on to isolate the bacillus of tuberculosis, to identify that of cholera, to add greatly to knowledge concerning the devastating bubonic plague, and even to plunge into the depths of Africa and bring back facts to aid scientists in their study of sleeping sickness.

Just as there are many, many men, women, and children who now bow in daily reverence before the memory of Madame Curie, not only because her work and that of her husband brought about the knowledge of radium as an agent to be used in the treatment of cancer, but because even while apparently absorbed in science—absorbed to the exclusion of all ordinary

human grief and suffering—she still was big enough, broad enough in her sympathy to look out across a world torn by the agony of a World War and to leave her laboratory to serve the League of Nations long and devotedly in the cause of peace. Whether she died, as some think, a martyr to her own science does not so much matter to the world at large as does the fact that such a woman lived in its midst, lived brilliantly, contributed immeasurably, but always with the quiet modesty of a really great soul.

III. *A New Vision of Health.*

But as Louis Pasteur had said, "Science in obeying the laws of humanity, will always labor to enlarge the frontiers of life." At the very time he was voicing that belief, the frontier he had done so much to erect was just being sighted by other men of clear vision. The frontier of preventive medicine. It had taken the followers of Hippocrates over two thousand years to clear a way through superstitions, traditions, blind suffering, and erect their first frontier, the frontier of curative medicine. But because they had done their work so well, because they kept right on maintaining it, because other men had brought the world closer together through their inventions for transportation and communication, Louis Pasteur was to see within his own lifetime his discoveries accepted and the whole world living in greater security because of them. Still more to his joy, if he had lived another score of years, he would have been very much alive to the fact that over against the world's sky line another, a third frontier, was about to emerge.

What would have greatly distressed gentle Pasteur was that it was to take a war, a ghastly tragic war, with all its destructive force, to rip through the indifference, the ignorance of men and discover the foundation facts

finally needed to build that third frontier. For these facts first became generally known when men were examined for service in the World War. In America, alone, fully one-third of those given the draft examination were found unfit to fight. If, the public asked, the world's sturdiest and best could thus fall below accepted standards of health, what could be expected of the rank and file left behind to carry on the business of everyday living?

A disturbing question. And yet even as it was asked, the most promising of that third was being sent off to training camps from which they were to emerge, only a few months later, erect, firm of muscle, and clear of eye—striking proof that men handicapped by all sorts of minor disease or health liabilities could build themselves up to a strength of body and mind equal to the demands placed upon it in No Man's Land. It was that proof which did its part toward extending the frontiers of medical science to include the vast possibilities of actually raising the health level of all apparently well. Since those apparently well numbered a majority far in excess of the few who were sick in bed, the promise of increase in human world power along that new frontier was immeasurable.

Surely if ever this world had need of such a promise—a promise of wholesome sound health for body and mind—it needed it in those war-ridden days when death was taking such ghastly toll of life, and hatred, vicious, ugly, was taking even a greater toll of man's

faith in man. Dared they hope—men and women standing far out on the ramparts of progress—to see that promise fulfilled?

Fortunately for the heartening of American leaders in human welfare, that war's training camp had not been the first experiment America had made in improving health of the apparently well. Fully ten years earlier a small group of far-visioned physicians had likewise disturbed mothers of the United States by the revelations of an examination of apparently well babies brought together in beauty contests. Naturally the mothers of those babies considered their infants one hundred per cent healthy as well as unquestionably beautiful. But when the physicians got through with their examinations those mothers sat back stunned with dismay. Negative, not positive, signs were scattered all over the blanks. Of course there were protests. But after those died away, there were questions of what could be done to build up the babies to their best. And right then and there non-scientific beauty contests gave way to baby health conferences conducted by doctors and nurses.

Mothers—yes, and fathers—were told very specifically and scientifically what they must do to give their babies the health chance that was coming to them. They took the advice home and worked on it, with the result that a large percentage of those penalized babies on entering a second year's health contest were marked high in improvement. Then came a combining of forces

—Julia Lathrop with her Children's Bureau; Dr. Lenna L. Meanes with her Committee on Woman's and Children's Welfare of the American Medical Association; public health authorities; women's organizations with their contact with groups all over the country. In 1914, Dr. Meanes' Committee prepared the American Medical Association's standard score card for well babies, together with a set of pamphlets by such recognized authorities as Dr. L. Emmet Holt and other specialists. Five million children under five years of age were put through the test in one year—full proof that parents in America were aroused to a realization that even their apparently well babies might not be at their best and that, if they were not, it was the responsibility of fathers and mothers to find out why and see what could be done about the matter.

Then came the follow-up. A follow-up continuing today, and so far as anyone can see is going to continue permanently in the various child welfare activities throughout the country. By the time, therefore, that the results of the draft examination were made public there were scattered over America a goodly number of scientifically trained men and women who were very much alive to the significance of those results. Also very much alive to what happened to those young men in training camps the world over.

So once more there was a combining of forces. Dr. Meanes, still chairman of her Committee in the American Medical Association, together with Dr. Anna L.

Brown and her Bureau of Social Education, National Board, Y.W.C.A., prepared an examination blank for women which the American Medical Association approved as its first card for adults. With that card, these two also presented and had approved by the Association, a handbook for guiding apparently well adults to higher health levels. Again, as in the material for child health, chapters for this were contributed by the highest authorities on nutrition, physical exercise, recreation, mental health. And also, again, the organized social forces of the country lent themselves to the distribution of this material and to the interpretation of programs for building up a new health consciousness throughout the land.

A consciousness that began and continued to center around the term "positive health"—a term which today is recognized as the goal of those working toward that new frontier looming higher and higher against the sky line of world welfare. Looming so definitely, so imminently, that those leaders who, back in the desolate war-ridden years of 1914 to 1918, barely glimpsed its radiant promise now can see their own generation beginning to realize some of the blessings which that promise will bring all humanity.

All through the years this new movement in health was taking hold of public thought, discoveries were being made by practicing physicians, and by those in laboratories, which added not only to the resources already developed for the control and prevention of

disease, but also to those for health-building. There was Casimir Funk, back in 1911, making the first announcement concerning vitamins, thus confirming what nutrition experts were saying of the necessity for selecting food with regard to individual health-building needs. There are all the new discoveries concerning exercise to build for health as well as to remedy health defects. There are the facts lately emphasized about recreation that re-creates both body and mind. There are those new, scientific developments in air conditioning, invaluable not only for the care of the sick but for comfort and efficiency in homes and in business.

And there, as we know, is August Rollier, turning the healing blessing of God's sun on open wounds, on thin diseased bodies, at his Leysin clinic, while at the same time rousing the whole world to question, "If that sun can so aid the sick, can it not do even more for the well?" The answer comes overwhelmingly not only in the brown-faced, brown-bodied people trooping back from summer vacations, but equally throughout the whole year from sun porch, from rooftop, from sunny open windows, where thousands from many lands are proving what the Swiss Alps peasants proved for themselves generations ago as they trusted their health, chiefly, to the sun and air of their mountain heights.

Walter Bradford Cannon

And while all these and a host of others have been reaching out into the world to tap one source of health-

giving benefits after another, still others have been delving deeper and deeper into the mysterious depths of man's physical and mental possibilities to find new resources of health, always there, but with the world unaware of their presence. Power to resist disease, power to resist infection, power to help control mental and emotional upheavals, power, in short, for the apparently well man or woman to build toward higher health levels than he or she had ever before conceived of as existing. Towering high in this group is Walter Bradford Cannon, who, born out among the lovely hills and lakes of Wisconsin, a few years after Louis Pasteur's discovery of his germ theory, was to graduate from St. Paul's public schools, then go on to Harvard to find his absorbing life interest in physiology.

By the time he had finished his medical course this interest had decided the line his life was to take. That was in 1900. Before him stretched long years of service as an instructor in physiology at Harvard, long fascinating years of laboratory investigations in which he was to solve as many mysteries of man's body as time, training, and his own eager desire could make possible. Even before that time, back in the first year of his medical studies, he had begun by using the X-ray to study the act of swallowing. With this early beginning he continued his observations of the alimentary canal, until, in 1910, he had accumulated the material published in a series of International Medical Monographs called "The Mechanical Factors of Digestion."

While busy with this he had been impressed by the effect of emotional control or lack of control on all activity of the body, especially as it affected digestion. If a man approached his food and ate it at peace with himself and the world, Dr. Cannon noted, digestion proceeded quietly and normally. If that same man became angry or unduly excited, Dr. Cannon noted that all sorts of interferences were set up between the taking of that food into his mouth and its assimilation by his body. From those particular observations he naturally passed on to further study of the sympathetic nervous system and the glands of internal secretion. By 1915, he had arrived at the place where he was ready to announce the results of his studies. That announcement came out in a volume called *Bodily Changes in Pain, Hunger, Fear, and Rage.*

A year before this second book appeared the World War broke out. With his experience in observing the influence of emotional disturbances on the bodily functions, Dr. Cannon's services were invaluable in connection with the study of traumatic shock—that shattering emotional reaction so often added to the other sufferings of wounded soldiers. In 1917 those services were under the British flag; in 1918 under the Stars and Stripes. He cooperated with scientists investigating the phenomenon. He was made, in recognition of his services, a Companion of the Bath by the British Government and received the Distinguished Service Medal from his own government.

After the war, Dr. Cannon returned to Harvard, to live, to teach, and to carry on his never-tiring research for the advance of man's knowledge of physiology. European colleges and universities—Wittenberg, Liége, Strasbourg, Paris—honored him with degrees. So did Boston and Yale in his own homeland. In 1931 Harvard celebrated the twenty-fifth anniversary of his appointment to the George Higginson Professorship. That same year, the Royal College of Physicians, in London, awarded him the Baly Medal. In 1932 he summarized his third group of investigations in a book called *The Wisdom of the Human Body*. That wisdom, he says, is centered chiefly in the stability of balance which the body so amazingly maintains throughout its intricate activities and under the manifold demands we constantly place upon it. A balance of reserve to offset outlay; a balance of nutrition against waste; a balance which the "fluid matrix"—made up of the circulating blood and lymph—nicely adjusts through serving without discrimination or favor each part of the body so that the whole may operate as intended. Gradually as Dr. Cannon develops the conception of this wise functioning of our inner self he sharpens a comparison between that functioning and a like functioning in an ideally smooth-running outside world. Why not, Dr. Cannon asks, set up the human body as a pattern for that ideal world?

And, at first, the reader, somewhat dazed at the very simplicity of the comparison, echoes, "Why not?", be-

fore he stops to remember that all the world has not come as far as Dr. Cannon has in becoming familiar with the body's wisdom. Just as it has not come far enough in its ideals of government to accept such wisdom as that set up in the creation of man. But, no doubt, Dr. Cannon, looking out from his laboratory with the never-ending patience of a great scientist, would tell us that the world has come far and having done so can go farther. Or, as Hamlet once said to his friend Horatio, "If it be not now, yet it will come: the readiness is all."

William A. White

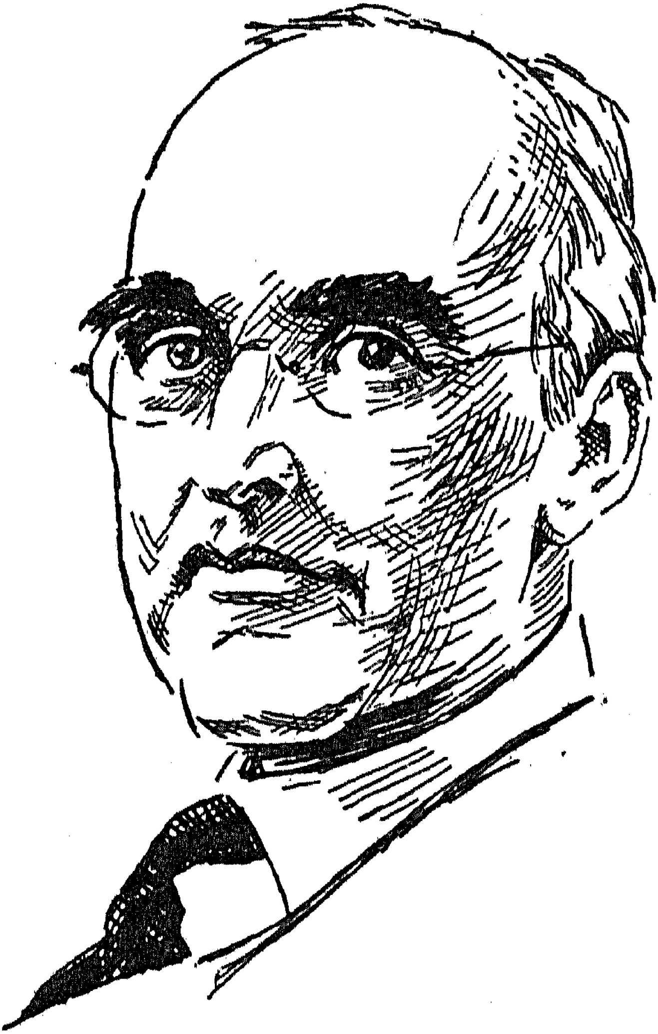
That "readiness" is likely to come and come more quickly when the world not only accepts an ideal of health which calls for "a sound mind in a sound body," but centers its efforts on making that ideal a practical possibility in everyday living. And such a possibility with the understanding of "sound" in this connection meaning positive health of body and mind. It is one thing, however, for a man to accept the fact that his physical health is far below what it should be and quite another for that same man to accept the fact that his mental health may also be far below what it should be. Nevertheless, whether he likes it or not, present-day science gives proof that many a man is going about with sufficient mental health to be classed as "well" who is thinking so crookedly, suffering so from being unable to adjust himself to his surroundings, as to be rated far

below what he could be in his mental health development. And what he should be, not only for his own greater happiness but for that of his fellow human beings. For, as a boy once said, "A square peg in a round hole is just as bad for the hole as it is for the peg!"

However, if that be true now, it may not always be true. For if the world has come far in its knowledge of how to make the best use of the body, it has come farther in a shorter time in its knowledge of how to make the best use of the mind. That it has done so is due to the work of such scientists in the field of mental health as Dr. William Alanson White, who says,

> The mind of man has in the present century come into its own for the first time as a worthy subject of scientific study and investigation.

Since by "this century" Dr. White means the nineteen hundreds, in which we are now living, it is easy to understand why our present conception of mental health is not what it may become as the "study and investigation" go on through coming years. Certainly Dr. White knows whereof he speaks. He was born in 1870, and for over forty years has kept as closely as any man living to the tragedies of sick minds, in his efforts to bring about a more humane and scientific treatment of them. Those efforts have carried him through all sorts of experiences outside the pale of most men's lives, experiences with agonized physical suffer-



Dr. William Alanson White

ings, with criminals cringing under the penalties of the law, with the hopelessly insane, as well as with those not hopelessly so.

To have all this crowded into one man's years, he must have begun early to live vitally and with a purpose. And William Alanson White, whether consciously or unconsciously, certainly was up and about his life's business before most of the small boys of his neighborhood dreamed of putting off childish things. Born almost in the shadow of the Long Island College Hospital, in the center of Brooklyn, New York, playing with the sons of men who worked in that hospital, he grew up as familiar with operating and dissecting rooms as other youngsters of his age were with the sunny space where they played their spring marble tournaments. Besides, there was his own particular schoolmate, a boy several years older than he, who had already made up his mind by the time he reached high school to study medicine. He talked of his plans long and late to young William White.

And William White listened greedily. By that time he also was in high school, just entering his teens, devouring everything put before him in natural sciences and showing so much understanding of the subjects that he was asked to help prepare lectures in physics and chemistry. He began the study of physiology. And it was then that all that had gone before in his hospital visits, all that he had drunk in so thirstily from the fathers of his small friends, merged into one broad

shining road—the road leading into the medical profession.

But how was he to travel that road? The White family was rich in sympathetic understanding but not rich enough in this world's goods to put this young son through the long years of training he must have to reach the goal he had set. But there was that loyal chum of his, the older boy, who had also decided that he was going to be a physician. He was going to study at Cornell University in Ithaca, New York. He knew of a scholarship which carried with it four years free tuition for the one who could pass the examination and be chosen by his district to receive it. Undaunted by his scant fifteen years, William White eagerly grasped at this opportunity. While his father and mother were away in the summer, he took the examination and passed. He, himself, says, "I felt I made a pretty miserable showing on paper." Nevertheless he had passed and, as his district had not used its full quota of applicants, he received the scholarship. On the return of his father and mother he announced what had happened. Then he was off to the university.

Alone. Full of excited dreams. Full also of Herbert Spencer, whose works had fallen into his hands, whose philosophy he had already grasped with an extraordinary understanding. Armed with this philosophy, and with not much else except the courage of youth, he descended from the train at Ithaca to face an entirely new world. A lonely world and a strange one.

Nevertheless he wanted to stay in that world. What is more he meant to do so providing he could make the authorities believe that he was sixteen, the earliest age at which the college would admit a boy. Was he to lose his first great chance for the mere difference between fifteen and sixteen? He gulped, swallowed his love of truth, and announced he was not only sixteen, he was seventeen! That hurdle taken, he found himself enrolled. He also found himself handicapped by a lack of preparation for University studies. On top of that he had to earn his own living. He got a job at fifteen cents an hour which later was increased to twenty-five. He added to that by tutoring.

In the meantime he was finding his chief interest at Cornell, as he had at Brooklyn, in the natural sciences. Physiology, geology, anthropology, chemistry, biology unrolled their fascinating stories before him. He listened with absorbed wonder to lectures on the structure and function of the brain, on anatomy, embryology, zoology. He seized eagerly upon his ethics instructor's definition of an educated man as one who "knew something of everything and everything of something." And he soon found out that while he could learn much and easily of science he was to have a difficult time learning even a bare "something" in Greek, Latin, and mathematics. But above all these experiences in his studies loomed high his contact with members of the faculty, who had in their turn come in contact with, had known, famous men of other lands,

men who had been to William White merely names on a printed page. For the first time in his life, the boy saw his world begin to expand, to include other worlds. Worlds where men had struggled and were still struggling to achieve something worthy of passing on from their generation to those who followed.

With that vision came a realization of his rich heritage from other men, other times, other lands. Equipped with that and with as much of the "something of everything" as he could carry, he left Cornell in 1889 to begin his study of medicine in the old and friendly Long Island College Hospital Medical College. Again he had to earn most of his own living. He gave anesthetics, he assisted at operations, he took on other jobs. He worked from eight in the morning until all hours of the night. It is not strange that, at the end of the two years' course—all that the school there required—he himself says, "I was pretty thin and pretty pale."

But he was also only twenty-one, and the world lay before him. His first entrance into it was as an ambulance surgeon in an emergency hospital in Brooklyn's busiest section. From there he tore out at any hour of the day or night to the clang of his ambulance to find and bring into the hospital strong men cursing their fate and begging to die, swarthy-skinned foreigners from the shipyards—mute and helpless in their suffering, little children caught in the city's traffic, pathetically white, limp, and still. Through other days and nights he

waited in the hospital as house surgeon to treat those ambulance victims, to meet stricken families, all the while young, vitally alive, wringing from his experiences a vast store of human understanding.

After six months of this he traveled over to Blackwell's Island to work on the Alms and Workhouse staff. At one end of the island stood a penitentiary, at the other an insane asylum. Across the East River he saw boatloads of Manhattan's down-and-outs come daily. He made his rounds among patients brought from New York's hospitals to die. Where in the Brooklyn hospitals he had seen human beings caught in some crash through no fault of theirs, he now saw them caught by the crash of their own daredevil living. What lay behind their reasoning? What lay behind the tragic inability to share life's responsibilities with other human beings?

A very short time at Blackwell's Island convinced William White that, equipped as he was then, he could not answer those questions. So he went back to his old school. And there in a dispensary dealing with nervous diseases, he discovered that all his previous learning about many things had been leading up to learning much about this one thing.

Because of that fact, when an inquiry came to his hospital—within a year after his return—for a young man fitted to be Superintendent of the Utica State Hospital, William White was recommended. Whereupon, he drew out every cent he had saved and was off to Albany to take the civil service examination neces-

sary for appointment to the position. But he stood fourth on the list of those passing that examination. Someone else got the Utica appointment. Nevertheless, he still had his recommendation from Brooklyn. He had made a fair showing in his examination. He was definitely, seriously interested. And there was another vacancy, that of an assistant physician at the State Hospital at Binghamton. William White was sent to Binghamton.

There he arrived, still in his early twenties, to look over the institution. Was he bewildered not only by what he saw of the extent of the plant, by what must be waiting there for anyone to do, but even more by the knowledge of what lay outside, waiting to be done in the whole world of the mentally afflicted? Scarcely a century had passed since men had begun to replace the age-old cruelty in treatment of the insane with more humanitarian measures. Pinel had done valiant service, in France, in that reform when he had lifted crazed men and women from bare stone floors, or heaps of dirty straw, to sleep on clean beds. He had done even more to restrain the lash of the whip, the use of cruelly cramping devices in controlling those violently insane. Others had followed Pinel in his reforms. Hospitals for the insane had accepted the more humane treatment, Binghamton among them. But about all that could be said even in the late eighteen hundreds was that a new era had dawned in the handling of mental sufferers; an era of greater kindliness necessary to

prepare the way for the era of science which was to follow.

For a young man with William White's vision and capacity for work, those early days at Binghamton offered the very opportunities he most longed for. He met and came to know Dr. Smith Ely Jelliffe, like himself young in the profession, and later an editor of the *Journal of Nervous and Mental Diseases*. Dr. White contributed to that magazine. Dr. Jelliffe sent him exchange journals from other countries. Dr. White made extracts from them, thus gaining a clear knowledge of what the world was doing in his own field.

On a visit to the new Pathological Institute established by the New York State Commission in Lunacy, Dr. White also became acquainted with Dr. Boris Sidis, head of the Psychological Department of the Institute. Dr. Sidis held that what the insane did and said was often of real significance in discovering the cause of their mental illness. The two men developed a strong friendship and spent many long hours in conference. Then, Dr. White began to study for himself the vague and apparently senseless talk of his patients for clues that might lead to a better understanding of their mental state. Tirelessly he continued his efforts. Sometimes he made as many as half a dozen rounds of the wards in a day. He followed every hospital routine with painstaking responsibility. When he was promoted, his work including the administrative duties of

an added valuable experience—he would be the better able to do some of the things he had set heart on doing.

Years passed, ten of them. Then in 1903, the head of St. Elizabeth's Hospital, the Government Hospital at Washington, D. C., died very suddenly just as he was beginning to execute a building program for which he had received a million-and-a-half-dollar appropriation from the government. Dr. White, then thirty-three, scientific, far-visioned, and progressive, was asked to take the position, and accepted.

He arrived at St. Elizabeth's in the midst of the confusion following the sudden death of his predecessor. On one hand he saw the very modern building program just starting. On the other he saw conditions dating back to the days when Pinel had begun his reforms. Patients were sleeping on bundles of straw in cells. Mechanical devices which he thought had been relegated to the ash heap along with age-old traditions and superstitions still stood prominent among the used furnishings of the hospital. Plunging into a very fury of work, Dr. White pushed the building as rapidly as possible. He went about constantly among the patients, coming to know them, listening eagerly to their disjointed talk, trying to think his way through their mental wanderings.

At the same time he accepted public speaking as part of his duties in a government position and as a means of clarifying his ideas to the public. He wrote.

He accepted a professorship of Nervous and Mental Diseases at Georgetown University and one of Psychiatry at George Washington University. He spent summer after summer in Europe, studying with great mental specialists, visiting institutions and laboratories. He became known abroad as well as in America. So well known, in fact, that when the first International Congress met in Washington, in 1930, he stood before it as president to outline the history of the mental health movement.

Today St. Elizabeth's sits proudly, serenely, looking out through old trees across its own acres toward Washington. The new building program of almost a generation ago is completed to include not only the wards for mental cases, a medical and surgical hospital, a contagious hospital, and cottages for the tubercular, but every equipment necessary for an organized, well-proportioned life of six thousand people.

Here and there patients walk about unguarded. Others work in the fields, still others in shops. Some are reading. And some are still behind locked doors. Dr. White moves among them knowing no distinction in his interests in St. Elizabeth's. His whole object within his hospital is to solve the mental problems of his patients as scientifically as present progress will permit and to maintain with them, while doing so, as contented and happy a day as their conditions allow. Such work for those who are mentally diseased is startling in contrast to that done a century ago for

similar unfortunate human beings. But even more startling and surely equally blessed is the recognition he and others are bringing about of the need of scientific understanding and care for those who, although not insane, not mentally diseased, are, however, mentally and emotionally ill. For this group he believes much can be done when society finds the right social level for each of its members.

A fair dream. Also one that is so much nearer its possible realization than it was many years ago when Dr. White began to work out his ideas that no man quite dares shut his eyes to any promise in the future. Even if Dr. White alone stood for what that generation has brought us we should have much on which to build. But behind him, as behind all the present-day conceptions of mental health, stands Freud, the first man to examine the mentally ill by the method of analysis. There are Jung and Adler, early disciples of Freud who later differed from him and founded their own schools of belief. There is Clifford Beers, not a psychiatrist, not a physician, but a person who, while mentally and emotionally ill, still had control enough of his faculties to follow his own case through and to write his astonishing record of *A Mind That Found Itself*. That done, he went forth from the hospital to help organize and develop the first program for the betterment of mental health the world has accepted as sane, practical, and within the grasp of those standing outside the realms of science. Through him, this program has reached out

from an American, or national, to an international interpretation.

Because of the work of these men and others like them, because of the whole world's advance toward a better understanding of what health means, the conception of mental health has now—within the span of one man's life—arrived at the same point where the conception of physical health arrived after many centuries of struggling against disease. Because this is true, it is no doubt one very good reason why Dr. White says,

> I for one verily believe that this century, which developed the World War catastrophe in its early years and led many to think that civilization itself was threatened, will ultimately prove to be the greatest of all centuries in accomplishments, particularly in the understanding of man by himself and in consequence a greater control of his destiny as it is worked out in the newly developed art of living.*

Not that anyone claims even in this "greatest of all centuries" that the fight begun by Hippocrates twenty-four hundred years ago is won. That fight against superstitious fear, against man's widespread

* *The Growth, Origin and Significance of the Mental Hygiene Movement,* Presidential address delivered at the First International Congress on Mental Hygiene, Washington, D. C., May 6, 1930.

ignorance concerning the structure and functions of his own body, against the dark mysteries surrounding the cause of disease, against the early trial and error in manner of treatment. One eternal, magnificent fight. One by no means to be swiftly or easily won.

Because it was not, medical science, gave twenty-three centuries out of those twenty-four to defending man's life and strength after disease had attacked him. Then Pasteur came to flood the whole world of man's welfare with the light of his miraculous discoveries for the control of infection and contagion. Immediately, here, there, everywhere throughout the world, specialists sprang up to interpret those discoveries for the protection of public health. Theories for pure water supply, drainage, destruction of disease-carrying insects, vaccination, quarantine were put into practice. Public health laws were passed, and enforced.

And for the first time in his history, the layman found himself, whether he would or no, taking his share in protecting himself and his neighbors against disease. Always, until then—less than a century ago—he had dropped all responsibility for even his own health on the shoulders of his devoted physician. Exactly as the islanders of Cos, the citizens of old Greece, dropped theirs into the lap of the gods.

How much that sharing of responsibility for public health had to do with man's later acceptance of his share in developing a higher health level for himself, nobody knows. What everybody does know, however, is that,

today, many of his kind not only have caught a newer conception of health—a conception including a greater and more secure strength of both mind and body—but are reaching out to take on an intelligent responsibility for attaining and maintaining it. With that responsibility has come a sense of what Dr. White expresses as "the understanding of man by himself and in consequence a greater control of his destiny." A control which is found to affect not only his own successful being, but, to an as yet unmeasured extent, the successful living of those about him.

PART TWO

Through Machinery

"He that invents a machine augments the power of man and the well-being of mankind."

—Henry Ward Beecher

I. *Communication.*

UNLESS, however, men in other fields had kept pace with those in medicine, the "enthusiasm" of Hippocrates, of Hunter, of Pasteur, might long since have been lost to the world. If the picturesque ships of the Mediterranean had not been cutting their way from port to port, the lifework of Galen might easily have begun and ended in Pergamus. If Phoenician rowers had not put off from their shores, the alphabet might never have traveled from Tyre and Sidon to Athens, from Athens to Rome, from Rome through Christian missionaries to all parts of the world.

But the Phoenician rowers were there carrying a "multitude of wares, with emeralds, purple, and broidered work and fine linen and coral, and agate." They also carried the alphabet. For they were shrewd merchants to whom the earlier system of marking off days and checking trades by knots tied in strings or by notches cut in wood or stone was a system too limited to express their intricate barterings. So they had taken characters from the picture writing of various peoples—Assyrians, Egyptians, Cretes—and made themselves a new system of writing to express their bargainings.

This system—the alphabet—was known in Greece five hundred years before Hippocrates began to record

his investigations. Paper was being made in China as early as two centuries before Christ, although it was not known in England until a thousand years later. By the time, however, that the fine accuracies of science demanded careful recording, communication had advanced sufficiently from its ancient crudeness to save the wisdom of early centuries for later generations.

But not far enough to meet the world's increasing hunger for knowledge. Knowledge, not only of health but of the manifold discoveries which the centuries brought for the greater ease of man's living. There were the political happenings, the news of wars, the joys and sorrows of great peoples which, then as now, human beings wanted to know. As early as 690 B.C. a sort of newspaper, a marble tablet relating matters of vital interest to the Romans, was exhibited in market places. And then, with the establishment of the Christian church, brown-robed monks bent endlessly over their parchment pages tracing the stories of the Old Testament prophets and kings, the gospels of the New Testament Apostles, and the creed of the Man of Nazareth.

When, however, the brilliant light of the Renaissance shot through the Dark Ages and men began once more to move ahead in their development, stone tablets in cities, exquisitely illuminated volumes chained to altars, stopped far short of telling the world all that had been and was being done for its betterment. To be sure, over in China, where learning had always been rever-

enced, a rude sort of printing had begun when the Chinese cut their old classics on tablets. Later, this same people invented a printer's ink from lamp black. And so far as anyone knows that ancient walled country can also claim the oldest printed book, through a volume dated 868.

Johannes Gutenberg

Nevertheless, while the Chinese went far, credit for the first practical printing belongs not to Eastern Asia but to Western Europe, where movable type was invented—some say by one man, some another, but it is generally attributed to Johannes Gutenberg of Germany, whose claim has survived almost unbelievable confusion and lack of proof throughout the four and a half centuries since he lived.

But it has survived to stand out, today, practically unquestioned although the man himself seems to have been curiously unconcerned about having his name connected with the work his printing press turned out. Evidently he considered that press of far greater importance to the world than he could ever be. And yet, despite that lack of concern about men's recognition of him in connection with his invention, despite the scarcity of accurate facts concerning his life, the man, Johannes Gutenberg, towers high through all the years between as a clean-cut personality of remarkable power.

Even the years of his birth and death are not known accurately. However, records agree that he must have been born in either 1398 or 1399. He was born in Mainz, Germany, of a patrician family, in the years when sometimes his class, the nobility, sometimes just plain citizens, held power; when plots, revolts, and riots were always rampant in his city, and when, in consequence, he and his people never knew how long they could hold their own against the opposing party. A colorful, fascinating time to read about, but probably anything but comfortable to live through.

Johannes' father's name was Gensfleisch, but according to a custom often followed at that time, his son took the name Gutenberg because it was the name of the town where his mother was born. His work later proves that he received the same sort of education other youths of his class received; just as years of exile prove that he paid the penalty of belonging to that class whenever the opposing class of Mainz won a victory. That exile was spent for the greater part in Strasbourg. One term of it began when he was a child, another when he was still a youth. The years between and after were spent very largely in Mainz. It seems quite likely that the women of his family escaped this exile and were able for a time to hold their property, or some of it, from confiscation.

But it stands to reason that a youth forced to flee his own city could not have carried much of his fortune with him. Also that such wealth as he originally pos-

Johannes Gutenberg

sessed must surely have been lost in the succeeding defeats of his party. At any rate, Johannes Gutenberg seems quite early to have turned soldier of fortune and gone tramping off, pockets empty, knapsack on back and staff in hand, along the Rhine, through Italy, Switzerland, and other parts of Germany. No doubt he had plenty of company—other young students visiting schools and universities, journeymen hunting for more promising shops and markets.

Of course, he heard and saw many strange things during those years. Out of the mass of them, one story has been told so often that many authorities have come to regard it as having a place in the history of Johannes Gutenberg's invention of his printing press. One day, this story runs, Gutenberg, while visiting the Cathedral in Haarlem, Holland, was shown a queerly wrought Latin grammar by Lourens Koster, a verger in the Haarlem Cathedral. The grammar had been printed from letters curiously and rudely carved on a wooden board; a process which, the verger claimed, had been discovered quite accidentally by cutting initials on a piece of wood hewn from a willow tree in the spring when the sap was running freely, wrapping the block in a piece of parchment, and then finding later that the initials had been reproduced on the parchment. Startled by the clearness of the letters, Koster had carved other letters on wood, used some sort of black liquid instead of the sap, pressed parchment over the wood, and —so it is claimed—produced the first proof ever printed.

Did that Latin grammar of the Haarlem Cathedral give Gutenberg his first glimpse of the invention with which he was to bring forth all the treasures then locked up in written manuscripts and make them available to his fellow men? No man can be certain about that. But what seems to be generally accepted is that not long after that visit to Haarlem, Dritzehn, an artisan of Strasbourg, brought down the law on Gutenberg for certain breaches of contract in connection with the handling of polished mirrors. To help prove his suit, Dritzehn vowed that the defendant was dealing in "black art" and launched forth in a description of what could be nothing else but Gutenberg's "movable types, forms and presses worked with a screw." All this, set down in a legal document recording Dritzehn's suit, shows that the printing press was in usable shape by 1438.

This means that Gutenberg must have spent long nights and days locked in a cell of the old monastery of St. Arbogaste, working secretly, tensely, to bring forth in practical reality the vision he had been carrying in his mind for no man knows how long. There, hidden away from his world, he had carved the letters of the alphabet on separate pieces of wood, formed these letters into words, arranged the words into the shape and size of a page; then, using brushes and ink he himself had made, he covered the surface, spread paper or parchment over the whole, screwed down the press, ran off as many copies of the material as he wanted, and then sepa-

rated the type so that it could be used for new material.

Of course such work took time, and money. Because it did he arrived at its completion with no funds to put his invention to use, and, apparently, with no influential friends to help him supply his need. He lingered on for a time in Strasbourg. He dropped out of sight for several years. And then, in 1450, he appeared in Mainz with Johann Fust lending him eight hundred guilders to help him on with his printing—lending it on security of tools yet to be made—and two years later repeating that loan.

With that help, Gutenberg began and continued the work of printing his famous forty-two line Latin Bible. Again he labored intensely. Finally, in 1455, the world saw his work completed with letters that stand forth with remarkable clearness, with pages spaced with a craftsman's skill, with initials and headlines illuminated by hand. In short, a masterpiece of dignified beauty and perfection.

And having so wrought, Johannes Gutenberg turned aside without leaving so much as a single mark to identify that book as the work of his press. In fact, while he kept on printing for a dozen or more years, no such mark can be found on any of his work. Fortunately, however, a deed of gift to his sister, a nun in the convent of St. Clara at Mainz, states that he gave her the religious works printed at Strasbourg, and promises her copies of all later works.

Sad to say, the work of those years appears to have been as lacking in financial returns as it was in the identification he failed to give it. Because of that, Johann Fust, seeing no sign of his guilders' being returned, summoned Gutenberg to court to give an account of his debt. Gutenberg did not even answer the summons—proof in itself that he had nothing with which to meet the debt. Thereupon, Fust seized all of Gutenberg's tools and material.

Nevertheless, it is said that Gutenberg later received sufficient help—probably in equipment this time—from a fellow townsman to set up another office either in Mainz or in Eltville, just outside that city. It seems that some of his old workmen returned to him so that he probably had a few years of printing in comparative peace. However, he may not have enjoyed even that short respite, for in 1457, the register of St. Thomas Church in Strasbourg begins recording failures in attempts to collect interest from Gutenberg for money borrowed as far back as 1442.

Finally, in 1465, when he was nearing seventy, he accepted a post as courtier from Archbishop Adolf. From that position he received enough to make life somewhat easier. He gave up his printing. Generally, the stories of his life end by saying he died two or three years later, still deeply in debt, a lonely man, and was buried in the Franciscan Church at Mainz.

A disjointed life story, fading away at times into deep shadows, flashing forth at other times in a bril-

liancy that has carried down through the centuries and lives today. Not even a genuine portrait of the man exists. But if the fleeting glimpses of his life tell anything, they certainly assure us that Johannes Gutenberg would have taken infinitely greater satisfaction in seeing his inventions put to everyday use than in seeing himself heaped high with honors. And they began to be put to such use within twenty years after his forty-two line Bible left his press. Put to use in Strasbourg, Cologne, Rome, Florence—in a dozen world centers, within the century of his death.

Four centuries later, Mainz, looking forth over the world to see the blessings this son of hers had brought to mankind, aroused herself and erected a monument in his memory. Since it is good for any man or group of men to express gratitude for benefits received, Mainz, no doubt, did well for herself. But—again—Johannes Gutenberg, if he knows what his world is doing, must take his satisfaction not in statues, not in any glorification of himself, but in the joy he has brought to humanity, everywhere, through the work he wrought alone, unaided, hidden in the monastery of St. Arbogaste.

That world, within a quarter of a century following Johannes Gutenberg's death, was to have added to it a whole hemisphere of strange waters and lands of which men of his day never dreamed. Even had they known of them, those men of Old World narrow boundaries could not have believed that, within three hundred years, a

whole nation would be established along the shores of that New World, a nation vitally alive and growing under the crisp red, white, and blue banner tossing in the salt winds of the Atlantic.

To be sure even in those late seventeen hundreds, after that nation was born, neither the output of Gutenberg nor that of any other printing press was doing much to enliven the wilderness cabins of America, to connect them with their distant neighbors, much less with centers of learning in the Old World. Post horses trotted here and there along the eastern seaboard carrying a letter, a thin little almanac, a scant fragment of printed news, from Boston to New York, from New York to Philadelphia, and to remote, lonely cabins in between. A slender thread of communication to bind such a far-flung people under one banner. And one that was slow in unrolling its length.

Samuel F. B. Morse

It was into such a land that Samuel Finley Breese Morse was born in Charlestown, Massachusetts, April 27, 1791. Born the son of Jedediah Morse, a fighting, orthodox, Congregational clergyman, a friend of George Washington, and author of the first American *Geographer and Gazetteer*. Also the son of Elizabeth Ann Breese, granddaughter of Samuel Finley, the president of Princeton College in far-off New Jersey. And small Samuel Finley, in the years ahead of him, was to need all the stern fighting spirit of his father, the pliable

Samuel F. B. Morse

strength of his mother, the devotion of both to the finer side of living, and their loyalty to the very new, very young land of America.

He was the oldest of eleven children, only three of whom survived the hazards of growing up in the New World. Perhaps that is why his parents were so eager to give him the best training they could. At any rate, small Samuel found himself bundled off to Phillips Academy at Andover when he was about seven. Of course he was homesick. Terribly so. But he stayed, and left there to go on to Yale when he was only fourteen, to ride there part way on horseback and part way by stage over roads cut through that wilderness by the same sturdy New Englanders whose shots had rung out across Lexington Green barely thirty years before.

Young Samuel stayed at Yale five years. Not a particularly brilliant five years but most demanding ones. Up at five, prayers and recitations before breakfast, followed by more recitations, a two-hour break at noon, and then classes again until five, with study for the next day often filling the hours after supper until midnight. During those years he caught, through certain lectures, his first glimpse of electricity's mysterious powers. But while attracted by that force, he was even more attracted by painting—so much so, in fact, that in 1810 he wrote his parents that he thought he would be a painter. He was then nineteen.

But Jedediah and Elizabeth Ann Morse had other plans for their son. Painting might be all right, but the

boy needed to earn his living, so they had decided to apprentice Samuel Finley to a bookseller at $100 a year. The young man stood the bookshop not quite three months. And then taking his life in his own hands, he left it to try his fortune at painting. Wisely his father and mother not only yielded but helped their son financially to the limit of their slender possibilities.

Within a year he had convinced his family and his master, the well-known Washington Allston, not only that he could paint, but that he needed to study in England. One way and another, he and his family got enough money together to risk the trip. He started in July, taking several days to travel down from Charlestown to New York, and twenty-two days to cross the Atlantic. That brought him to London in the fall of 1811. He stayed on there until 1815, thus living among the British throughout the years of the War of 1812, a time of violent English activities against his own country as well as of all Europe against Napoleon. Nevertheless, despite such distractions he was fortunate enough to meet and study with Benjamin West, the great English artist.

He made such headway that 1816 found him back in America sufficiently sure of himself as a portrait painter to marry Lucretia Walker of Concord, New Hampshire, certain that before long he could and would be well enough established in some one place to have a home and a studio with clients to pay for both. One wonders what would have happened to his high-hearted courage

if he could have foreseen the years ahead. After shifting from Charleston, South Carolina, to Washington, from Washington to Albany, from Albany to New York; after painting the portraits of President Monroe and the members of the House of Representatives, he won an appointment to paint Lafayette during that great Frenchman's visit to the United States in 1825.

He arrived in Washington, February 8, 1825. He met Lafayette, breakfasted with him, and then and there began a friendship which lasted until the death of Lafayette. He rode to a White House gathering with J. Fenimore Cooper, and another lifelong friendship was formed. And all through those wonderful days, days when the home he longed to have seemed almost within his grasp, his young wife had been taken ill, had grown steadily worse, and then had died before the slow-traveling post could bring him word of her suffering. Even the funeral of Lucretia Morse was over when the news of her death reached her young husband.

The day after that word reached him, Morse went back to New York and plunged into work as his only salvation. The portrait of Lafayette was finished and hangs today in the City Hall of New York. That same year, 1825, he organized what is now known as the Natural Academy of Design, became its first president, and continued to hold that office for twenty years. The next year stern, fighting Jedediah Morse died. Less than two years later, his wife followed him. And the next year found Samuel Finley, their son, on his

way to Europe. Lonely, yes. But filled with the necessity of justifying his heritage from them, of filling his days with achievements worthy of them and his young wife.

He stayed in Europe three years. He was forty-one—his life span half crossed—when he started back on the *Sully*. One day, October 1, 1832, he happened to be listening to one of the passengers tell of discoveries in electromagnetism just made by European scientists. Those scientists claimed that electricity could and did pass through any known length of wire and that if the circuit were broken at any place along the wire its presence could be seen. Suddenly Morse exclaimed,

> If the presence of electricity can be made visible in any part of the circuit, I see no reason why intelligence may not be transmitted instantaneously by electricity.*

Nobody answered. Swept with excitement Morse left the group to walk the deck back and forth, back and forth, his whole brain flaming with the light of the vision he had just caught. A vision that some way connected with that long-ago experience of his Yale student days when he had sat spellbound listening to those lectures on electricity. Strange how that interest had been crowded out by his artist's dreams of over a score of years. Stranger still how naturally all he had learned there, all he had observed since, culminated within a

* *Letters and Journals of Samuel F. B. Morse*, edited by E. L. Morse, Houghton Mifflin Company.

few hours on board that boat in sketches and notes which, carefully preserved in the National Museum at Washington, show that the telegraph, practically as used now, was born that day on the *Sully*.

But between that October day of 1832 and the completion of his invention, the telegraph, for public demonstration, twelve years were to elapse, twelve years of bitter disappointment and sacrifice. To begin with there was his painting. He had spent half his life preparing himself and reaching the peak of professional approval which was his at forty. He needed all that profession could bring him financially to live and provide for his growing children who at the death of their mother had been given homes by relatives. Down in Washington, there were four panels in the Capitol waiting to be filled in by some artist of established standing. Morse had every reason to think he might be chosen to do one or more of them. He applied, waited three years for a decision and then, when it came, found his name was not among those chosen.

At that time something went out of his life as a painter. To be sure, he still painted, since he had to live, but more and more he became absorbed in his experiments with telegraphy. In the meantime, in 1835, he had been appointed professor of the Literature of the Arts of Design in the University of the City of New York. That position carried with it the use of a studio in a building not yet completed. Nevertheless, Morse moved in, and there made his first rude model of the telegraph. He

cooked his own meals, carrying his groceries in at night so no one would know how low his funds were. He worked endlessly, sometimes in hunger, often in great weariness. He toiled long precious hours over parts of his machines that any good mechanic could have made swiftly and easily if Morse could have afforded to hire him.

None of this daunted Samuel Finley Morse, for he had caught a vision and fixed it for realization. By October, 1842, he had completed a machine which he felt could stand public exhibition. A wire was stretched from the Battery to Governor's Island. Morse took his place at one end, his assistant at the other. A few signals flashed. Then silence. Out in the bay, a ship's anchor had caught in the cable and had dragged it several hundred feet. Then the vessel's officers had ordered the cable cut and had sailed gaily off, leaving the crowd on shore to vote the new invention a grand fraud.

That was a sickening blow to Morse. But he rallied and a few months later was down in Washington waiting in insufferable distress for Congress to pass or fail to pass a bill allowing him $30,000 to prove the value of his instrument. At last, Congress passed it. By the following May—1844—he had his wire stretched between Washington and Baltimore and had flashed along it the first Morse message, "What hath God wrought." That acknowledgment made, the news of James K. Polk's nomination for the presidency followed. Excitement was tremendous. Other announcements

flashed along the wire to be received with staggering speed and accuracy.

Samuel Morse was then fifty-three. He lived on to be eighty-one, lived to make other trips across the ocean, to be honored by the whole world, to meet and wage legal war against scores of contestants who claimed to have invented the telegraph before he had caught so much as his first vision of it aboard the *Sully*. Perhaps some of their claims were true, but Samuel Morse was able to prove that he had been the first man to stay by his invention until it became the practical benefit it now is to all humanity.

Five years after the successful demonstration at Baltimore, Morse was able to buy a home for himself. His first. He chose about a hundred acres lying along the Hudson between the Fishkill and Catskill Mountains and there, the next year, he brought his second wife, Sarah Elizabeth Griswold, and began the sort of life he had dreamed of living over thirty years before.

On his eightieth birthday a great celebration was held in New York City. There, on the stage of the Academy of Music, the original instruments used in Washington and Baltimore were set up on a table and connected with all parts of the world. Morse, himself, tapped out a greeting to the "telegraph fraternity throughout the world." At the end the audience rose, cheering wildly. The current was then switched back stage and instantly answers came pouring in. Morse sat overwhelmed with emotion, his face buried in his

hands until in response to an appeal from the audience he rose and said of his invention:

> My most powerful stimulus to perseverance through all perils and trials of its early days—and they were neither few nor insignificant, was the thought that it must inevitably be world-wide in its application, and, moreover, that it would everywhere be hailed as a grateful American gift to the nations.*

That celebration was April 27, 1871. The next January, Samuel Morse appeared—against the wishes of his physician and family—at the unveiling of a statue to Benjamin Franklin. The day was cold. Bareheaded he rose and said:

> Franklin needs no eulogy from me. No one has more reason to venerate his name than myself. May his illustrious example of devotion to the interests of universal humanity be the seed of further fruit for the good of the world.*

After that he went home to walk the floor for long hours with neuralgia. Even his sturdy body shook under the attack. After all, he had used that body to its limit of endurance for four score years. Rapidly now its strength grew less. The end came in April. And with it came a flood of messages from his "telegraph chil-

* *Letters and Journals of Samuel F. B. Morse,* edited by E. L. Morse, Houghton Mifflin Company.

dren" everywhere—messages of sympathy and grief for the man who in his own lifetime of work had brought not only the vast stretches of his own land within immediate contact one with the other, but the far reaches of the world as well.

Alexander Graham Bell

Even as Morse was expressing his hope for the work of Benjamin Franklin, a young Scotchman named Alexander Graham Bell, living up in Boston, was working day and night on experiments to develop through the power of electricity, "further fruit for the good of the world." Thumping a tuning fork, experimenting with a string stretched from his window to that of a friend, trying this and that, he was often voted to be just "a little mad" perhaps, but even so worth putting up with because of his vivid and delightful personality.

Like Samuel Morse, Alexander Graham Bell brought with him into this world a family heritage of service for others as much a part of his make-up as the blood of his being. There had been his grandfather, living in St. Andrews, Scotland, also an Alexander, who had left the family shoemaker's bench for the grocer's counter, and then had left that to connect himself with the Theatre Royal in Edinburgh. But for some reason he did not remain on the stage. Instead he became a reader of Shakespeare's plays, a specialist in correcting defective speech, a teacher of English diction, and finally head of a boys' school. All these activities he

handled so well that he was able to retire to a comfortable home in London, where his small grandson, Alexander, was to delight in visiting him and in being taught to recite Shakespeare.

Alexander Melville Bell—son of the first Alexander and father of the third—had been taught by his father, and had gone on from that teaching to lecture on various phases of diction in Edinburgh, and then to cross the Atlantic and continue his work in Canada, Boston, and Washington. As his interest increased so did his work and fame. Today, he is particularly known for his work in teaching deaf-mutes to speak. In his *Visible Speech*, he sets forth symbols representing the position taken by the lips, tongue, etc., in speaking. His wife, the mother of Alexander Graham Bell, the daughter of a surgeon in the Royal Navy, was a painter of miniatures and a musician of rare ability.

It was into this home that Alexander Graham was born, in 1847, the second of three sons. From his earliest years he was taught music, good speech, and much of acoustics. He grew up in Edinburgh just when the electric telegraph—completed by Morse in 1844—was being introduced into that ancient city of towering castle walls, of stories of her disturbing majesty, Mary Queen of Scots. After studying at home, he began his formal education at ten with a year in private school, followed by the Royal High School, where he was graduated. He finished with lectures in Edinburgh and London.

Finished, that is, his attendance at any seat of learning. This by no means tells the whole story of his education. There was, for instance, his father offering his growing sons a prize for trying their hands at an automatic speech invention. There was his grandfather, with whom he spent a year in London, teaching the lad everything from carrying a London walking stick and wearing a top hat to speaking in public. Then after his grandfather's death his own family spent much time in London, met and made close friends of prominent scholars interested in languages, in physiology, in mental health.

With all this, by the time he was sixteen, Alexander Graham decided he was fitted to begin life for himself. He therefore took over some work as a pupil teacher in Elgin and began for the first time to study sound by himself. He did so well that, five years later, when his father was invited to lecture at the Lowell Institute of Boston, Alexander Graham was given full charge of his father's London work. Of course he liked that—liked it so well that he worked himself to the breaking point. Since one of his two brothers had died several years earlier of tuberculosis of the lungs, and the other had followed from the same disease three years later, "Aleck's" parents lost no time deciding to take him out of fogbound London into a land of clean, pure, healing air.

Since no land gave greater promise of that than Ontario, Canada, the family left all associations in

England and Scotland, all the father's professional contacts there, and sailed for America. There on Tutelo Heights, near Brantford, young Bell began his fight for health, and won that fight with amazing swiftness.

Won it so completely that at twenty-three he went to Boston to take over his father's work there, the latter having begun other teaching in Canada during his son's ill health. The son had no trouble whatever in filling his father's engagements. And no more in teaching in the School for the Deaf, in Boston. In fact, the latter work was so successful that he went to Northampton to repeat his lectures there in what is now the Clarke School for deaf-mutes. Teaching here and there, spending his summers in Brantford with hours at the piano singing a single note and listening for its reverberations along the same piano key, and altogether earning a reputation for being a "little queer," he decided by 1872, when he was twenty-five, that the time had come for him to open up his own "school of vocal physiology," in Boston. This he did, and he began there his courses in the correction of speech deficiencies and in the teaching of visible speech to the deaf.

He began, about the same time, his friendship with Mabel Hubbard, which was to end in marriage after five years of impatient waiting for both of them. For Mabel Hubbard was the daughter of Gardiner Greene Hubbard, a son of Boston's richest man, who while greatly interested in Bell's work could not bring himself

to trust his daughter's future to a young man absorbed in curious sound experiments to the exclusion of all demands for comfortable everyday living. But, while Mabel was wealthy, while she was accustomed to all the ease of her class, while she was ably and finely educated, she was also deaf, and had been so since scarlet fever had attacked her as a little girl of five.

Because of that, her father, a man of broad interests and of valuable political influence, was tireless in his efforts to bring help to other deaf children. At the same time he had sent his own daughter to Germany to learn lip reading and was rejoicing over her return when young Alexander Graham Bell first set up his school in Boston. Quite naturally he saw in the young Scotchman an opportunity for his daughter's further education.

Young Bell at that time—1872—was teaching all day and working all night on experiments which were to result later in the multiple telegraph. As a result his health broke and he returned to Brantford to rest. By the next year, however, he was back, boarding at Salem with five-year-old George Sanders' grandmother in order to teach the little fellow—born deaf—how to speak and read.

He was also going on with his teaching of private pupils and classes in Boston and with lectures at the School of Oratory of Boston University, as well as his laboratory work, which was gradually absorbing his attention to the exclusion of other interests. There was his interest in flying, even then beginning to tease him

for expression, and always there were those experiments which were gradually leading him to believe that some day or other he could send his voice down a wire to be heard as distinctly as the rat-tat-tat of the telegraph then was heard over world-wide spaces. While working on these experiments, he had several years before met Dr. Clarence Blake, a famous aurist, who suggested that Bell study the ear of a dead man as a part of the necessary work for his invention.

By 1874, that ear in his possession, along with other material, he again traveled to Brantford for the summer, went off, as his father said, into tantrums—and emerged with the telephone conceived exactly as he was, later, to direct its making. That fall, as soon as he returned to Boston, he got in touch with the father of little George Sanders, the father of lovely Mabel Hubbard, the father of Dr. Blake, and told them of his dream of sending the human voice over an electrified wire. The first stood ready to back him with money, the second also offered to share the expense of producing the invention, the third gave him a room in a building he owned in Boston.

And there was also Tom Watson. Twenty-year-old Tom, an electrician in a Boston shop, whose work Bell had tested and liked so well that he had sought him out, and, finding him as loyal and quick as he was skillful, serene, and sure, had trusted him with his dreams, told him his half-worked-out plans, and finally shared with him his long nights of experimenting.

But Hubbard wanted the multiple telegraph—on which the young man had so long been working—finished before Bell did anything else. Bell, desperately in love with Mabel Hubbard, naturally listened to her father, and finally went down to Washington in February, 1875, to apply for a patent for that invention. On his return home there came word that one Elisha Gray had previously applied for a like patent and that his—Bell's—interfered with Gray's. By that time, however, Bell had become so absorbed in his work on the telephone that nothing else mattered. He gave up all teaching except that of little George Sanders, and with it all income except what he received for his work with that small boy. Several of his patents were granted that spring, but even that news failed to turn his attention from the telephone.

Then, quite accidentally, one day, Watson, seated in a room sixty feet from Bell, transmitted one sound in all its complex vibrations along the wire to catch Bell's ear. And Bell knew he had won. For, he reasoned, any instrument that could transmit one sound in all its completeness could do the same for any sound—even speech. Of course the two young men were tremendously excited, but not so much so as to be unable to work coolly and swiftly. Before Watson left that afternoon Bell had given him directions for completing the first electric telephone.

Then came a year of working, of testing, of experimenting, with Hubbard urging Bell to file his applica-

tion for a patent. At last, in utter discouragement over the younger man's delay, he—Hubbard—took matters into his own hands and made the application. That application was allowed and the patent granted March 3, 1876, the same year that the Centennial Exposition was held in Philadelphia. Having done so much, Hubbard arranged for Bell to set up his invention under the Visible Speech Charts of the Massachusetts Educational exhibit, and to make his demonstration of it on June 25.

That was on a Sunday, a very, very hot Sunday. Bell sat waiting for the judges to arrive, every nerve tense to snapping, suffering desperately as he always did from the heat. He saw them coming slowly, stopping interminably long at each entry. He was just about to despair of their reaching his exhibit that day when Dom Pedro, Emperor of Brazil, honored guest of the Exposition, who was with the judges, recognized Bell, whom he had met a few days before in Boston, stopped, became interested, and asked for a demonstration of Bell's invention.

Bell's great hour had arrived. Picking up his phone he spoke to Willie Hubbard over a wire stretched to the far end of the hall. Contact was immediate. Then, a true son of the Bell family, he began to recite Hamlet's soliloquy, "To be or not to be, that is the question." Clearly, distinctly, every word carried to Hubbard, to Dom Pedro, and to the judges who were taking their turns listening. Alexander Graham Bell forgot the heat,

forgot everything except that he had proved what so many years before he had started to prove—that the human voice could carry over any distance through which an electric wire could be stretched.

That summer, Bell extended his demonstration over longer and longer distances. One of these was carried out between Tutelo Heights, his parents' home, and a town two miles away. Chief Johnson of the Mohawk tribe helped him attach the last half mile of wire and spoke in his native tongue across the distance when connections were established. Even then, among that stalwart Indian's people, picture writing was still the only method of keeping records. Fleet, silent-footed messengers were the only means of communication over long trails from one cluster of Indian tepees to another.

The next year Bell and Mabel Hubbard were married, an evidence that Gardiner Greene Hubbard felt that his faith in young Bell was justified in the practical value of the telephone. But, even so, even with his demonstrations proving successful everywhere, even while traveling abroad with his wife to receive triumphant welcomes along his whole route, troubles were heaping up for him. Others claimed they had preceded him with their inventions of the telephone. Some had. But steadily through nearly six hundred lawsuits Bell fought for his claim of having brought the invention to its first practical use. And won.

For many men, those years of struggle would have filled their days to the exclusion of everything else. But

not so with Alexander Graham Bell. There was that dream of flying which had distracted him for so many years. Now, more or less free, he surrounded himself with young men and began, in earnest, to see if that dream could come true. There was that belief of his that a bullet in the body could be located by electricity, a belief so convincingly set forth that he was permitted to make a trial with President Garfield while he was lying between life and death from the shot of an assassin. There was his study of the part heredity played in deafness. And a host of other ideas which seethed about in his active brain just waiting for a chance to be given a practical working out.

In 1882, the Supreme Court of the United States made him an American citizen. But while he honored his new country by developing his outstanding invention in it, he maintained his loyalty to Canada. Three years later he bought his summer home there—a whole hill in Cape Breton, where he surrounded himself with men of his own interests, young, vigorous men, whose enthusiasms he shared, and where his wife stood ready always to help his dreams come true not only by her belief in them but also with substantial financial encouragement.

Between visits to Scotland, a trip around the world, and work in his laboratory, Bell went down to New York in 1915, to open the coast-to-coast telephone. Tom Watson waited at the other end of the line in San Francisco. Did the two of them go back in their

minds to that night in Boston, over forty years before, when Bell burst in upon Watson, blazing with excitement over the certainty that the sound he had just caught at the other end of the wire from attic to cellar held the secret of all future telephoning? No doubt each did go back to that night. And with tremendous satisfaction, as the sound of their voices carried with amazing clearness across the whole vast East-West stretch of Uncle Sam's proud domain.

When he hung up the receiver after that coast-to-coast talk with Tom Watson, Alexander Graham Bell was nearing the end of his allotted three score years and ten. Nevertheless he went back to his laboratory, his mind seething with ideas he wanted to carry out—ideas particularly about flying and boating. He worked there and elsewhere for seven years before his strength broke and he began in the summer of 1922 to hurry—hurry breathlessly—to finish some of the things he still wanted to do.

But no life would ever be long enough to do all that a man like Alexander Graham Bell sees to do. The end finally came the night of August second. Perhaps he was more ready to go than his friends had thought, for there were all his funeral plans—simple ones—carefully set down by himself. His coffin was made in his laboratory—made of pine from the trees of Cape Breton. The suit he wore for his burial was an old homespun one, threadbare from work in that same shop. The only honorary pallbearer following him to the grave

on a near-by hill was an old assistant blinded in that shop.

Guglielmo Marconi

Measured by itself that transcontinental talk of Alexander Graham Bell and Tom Watson was a marvelous triumph in science. Measured against that of Samuel Morse it loomed high. But fourteen years before those two men lifted their instruments to speak quietly across miles and to hear each other as distinctly as if sitting in the same room, a young Italian, Guglielmo Marconi, had transmitted his wireless signals from an old barracks, near St. John's, Newfoundland, to Cornwall, England. Men gasped. Was there to be no limit to the cutting of space between men? If sound carried miles without even the material connection of a slender wire, carried across the ocean without the bulk of a cable wire to support it—what was to be the future of man's contact with his fellows?

To Guglielmo Marconi, however, the whole secret of his successful experiment was only a natural result of the laws of science painstakingly applied. Born in Bologna, April 25, 1874, of an Italian father and an Irish mother, educated in that town, in Florence and Leghorn, he could not remember when he had not been fascinated with physical and electrical science. By the time he was sixteen he had advanced so far in his study of that science that his father gave him a full set of equipment to carry on his experiments. When he had

Guglielmo Marconi

reached twenty-one he had no doubt in his mind that sound could be carried on through space by means of electromagnetic waves. Others, older and better known men than he, believed the same.

The summer of 1895 found him setting up an awkward apparatus at his father's country home at Pontecchio, turning the whole estate into an experimental station and sending out signals which carried a mile away. The next June, he was over in England, putting on a demonstration before representatives of the British and foreign governments. He extended his experiments to two, four, nine miles, and then across the Channel. One year later, the Italian government asked him to demonstrate his system by sending a message from Spezia out to Italian warships twelve miles from shore. That, and a second demonstration before the King and Queen of Italy, were both most successful. In July of that same year, a company was formed in London, later to be called Marconi's Wireless Telegraph Company, Limited, whose efforts were all toward furthering the young man's work. Between that summer of 1897 and the winter of 1901, he strode ahead until he had sent his wireless messages successfully over a distance of two hundred miles.

That accomplished, he concluded he was ready to span the Atlantic. So he sailed for Newfoundland to test the wind's velocity with his kites, and, on December 12, to hold one successfully in the air four hundred feet high, and then with a telephone at his ear to seat

himself at a table equipped with a receiving instrument, and wait. A wire ran out of the window near him to a pole and thence upward along a tall mast. It was a bleak winter day. The Atlantic beat against the foot of the bluff below the young Italian. Aloof, quiet, he sat there waiting for the noon hour when, according to plan, Cornwall, England, was to tap out the three dots —the signal agreed upon. He waited for half an hour longer. Then faintly but unmistakably the Morse signal struck his ear. And with that, another man had added his contribution toward destroying the barriers of space between men.

On his way back across the Atlantic, Marconi received a wireless from a distance of two thousand miles. After that, in the years immediately following, the distance for carrying such messages continued to extend. No space was too great, no wilderness too tangled, no stretch of water too vast, no climate too extreme in heat or cold, to stop, for long, the vibration of air waves carrying the sound of men's voices, men's activities hither and yon over the world's surface. Even the boast of Will Shakespeare's tiny imp-like Puck, "I'll put a girdle round about the earth in forty minutes," was put to shame. The minutes were cut to seconds.

By the time the World War came, therefore, Marconi had this new magic of science developed to where he could adapt it to war activities. He himself served in

the Italian Army and Navy during those terrible years. But as was natural for any man whose interests were all centered in building rather than destroying man's resources, he wanted the war to end swiftly. He wanted peace. Because of his sane and intelligent views, he was sent to the United States on a war mission to represent the Italian government. In 1919, his King appointed him plenipotentiary delegate to the Peace Conference in Paris. Thoroughly kind and modest, but keenly alive to his responsibilities, he gave the best of himself wherever he was placed. At the end of that famous conference, he signed the treaty of peace for Italy. After that he also represented his King at meetings in Paris and London where mandates were established for the protection of small countries.

Since those days he has continued to serve both his own country and the world, both his own field of science and the broader field of human welfare. Honors have been and are being heaped upon him. As far back as 1909, he received the Nobel prize for physics. That same year he was named by the King of Italy to serve in the Senate of his own government. England has conferred upon him the Albert Medal of the Royal Society of Arts. The United States has presented him with the Franklin and John Fritz medals. In May, 1935, the Chair of Electromagnetic Waves was instituted in Rome University and filled by him. And each year when December 12 rolls around, the minds of men

everywhere turn in wonder and gratitude to that bare room high up on a cliff overlooking the stormy seas of Newfoundland where Guglielmo Marconi sat so quietly sure, that other December noon of 1901, and heard by means of invisible waves his first signal flashed through the air across the Atlantic from Cornwall.

II. *Transportation.*

Even back in the dawn of creation, back in the time when days were recorded by knotted strings, man had begun to move himself and his possessions from place to place. Or, rather, to be accurate, he moved himself while the woman of the race loaded the family belongings on her back and trotted along in the rear. Very likely their going was urged on by hunger. Food supplies in one region gave out and another farther on promised plenty.

Some way or other, despite his very simple manner of living, early man added to his possessions—added skins, rude tools, weapons. They became too numerous, too heavy for the woman to carry along with the baby strapped to her back or bumping about in a net or basket along with the stone ax and spearheads. When that time came, somebody or other invented a sort of sledge by cutting down a small forked tree, trimming off the branches to leave only two extending from the trunk, and then binding stout branches or stretching skins across the angle thus formed.

Just as early man turned to the forest for a forked tree to make his sledge for land traveling, he also turned to it to solve his problem of traveling by water. Probably his first boat was only a sturdy log, astride which he sat

and paddled his feet and legs to propel himself from shore to shore. Later, he hollowed out the log, devised paddles, and made himself a canoe. Or, as he became more deft with his tools and hands, he twisted branches into a curious bowl or tub shape, covered them with skins—or woven reeds—and a lighter boat was added to his vehicles of water travel. Fortunately for the boatman, riverways were always there. Currents were also there to give him his general directions for going and coming. Banks of streams, even shores of larger bodies of water, furnished much more outstanding points of location than an inland forest, with its heavy undergrowth and dark shadows. Naturally, therefore, men were to go farther by water in those early ages than they were by land.

And they continued to do so long after those first timid ventures were made by sledge and dugout. Boats with oars and sail were plying up and down the Nile six thousand years before the birth of Christ. The Phoenicians, migrating from inland Palestine to a narrow strip along the Syrian Coast, found that their only advance after that would have to be by sea. So they built ships. Ships with picturesque bows and sterns, with sails of purple and crimson and gold, with crews of as many as one hundred and twenty oarsmen.

And with those ships they traveled west through the Mediterranean carrying their cargoes of men and goods. And the alphabet. Homer, living nine hundred years before Christ, writes of the marvelous staunchness and

sure sailing of the boats of Ulysses. The Romans, strange to say, were rather indifferent at first to sea travel, but when the Carthaginians threatened to surpass them by activities on water, they captured a Carthaginian vessel, used it for a model, and built a fleet to conquer their enemy. Then they built a splendid merchant vessel, carrying three sails, and were off to England. There the Vikings gazed curiously at the ship scudding swiftly along with the wind, added sails to the force of their own oars, and continued their endless prowling about on cold waters until they nosed into the frozen shores of northern America, nearly five centuries before Columbus put out from Spain with his three small ships to find a new western world.

This far-flung travel by sea was all very well, so long as men crowded down to the banks of large streams, to the edge of the sea to live. But the human race grew in numbers, in enterprise, in a venturesome spirit. Water might be the most convenient means for transporting products for trade, but the products came largely from the work of men in towns and fields, in mines and forests. Something more than rude sledges hauled by human beings was demanded if those men were to get those products down to seaports, or even to the markets springing up far inland.

So long caravans of camels began to carry rich spices and gleaming silks from Eastern Asia to the south and west across wide stretches of desert land. Elephants, with trappings of Oriental splendor, trod heavily under

human or commercial freight along the southern Asiatic coast. Years, countless years, passed, and then from the Mediterranean, back from coast towns everywhere, rude roads began to be cut. As the Romans extended their far-flung domain north through Europe, they came to realize that if they were to retain their colonies they must be able to reach them more easily and quickly. So they built roads. Built them continuously from 305 B.C. to 200 A.D., until twenty main highways led into Rome, paved often to a thickness of four feet, measuring often thirteen to fifteen feet across, and branching out to form 372 different routes connecting the Roman Empire.

In the meantime, the rude sledges of primitive man had been lifted on logs, the logs had been rolled forward, and the idea of a rotating force to move a burden had come into existence. The wheel, first of solid wood or stone, then with a hub, spokes, and a rim, followed on all sorts of vehicles from carts to chariots. Oxen and horses took the place of human beings in hauling these. By that time the world had come a long way since man had first glimpsed a sledge in a forked tree.

But when Rome fell, European progress, in general, was halted for centuries. When the people of that continent began to emerge from the darkness and confusion of those dark ages, it was not the voice of the Mediterranean countries, the ancient civilization of Egypt, Syria, Greece, and Rome that reassured man, but that of lands far to the north.

In Germany, for example, came the first signs of progress in transportation when two-wheeled carts topped by wooden boxes came into use in hauling and traveling. Seventy-five years later, in France, the government ordered all roads improved. Less than a century after that Paris was threaded by wheeled coaches, carrying royalty.

Quite naturally, common people watching the gay court people ride by wanted a chance at the same ease. It took a scholar, a philosopher, Blaise Pascal by name, to make their wish come true when he invented the omnibus in 1662. Three years earlier, over in England, a wagon drawn by six horses and carrying a load of passengers was venturing along the rough, robber-infested roads from London to Dover. Men had begun to go places, and to see other men. Never again was the world to be closed within its old sky line.

George Stephenson

Before the next century had passed, George Stephenson, the English collier, had begun to peer curiously at James Watt's steam engine and to wonder whether its power could not be put to other uses than that of pumping water from the coal mines about Newcastle. That idea was one to dwell upon. Every man George Stephenson knew was connected in some way or other with those mines. His own father, Robert Stephenson, had worked in them ever since he could remember, first as a general laborer, then as fireman. He earned at

the most a dozen shillings a week to spend on his hungry, growing family of six. George's mother, although never strong, had also worked to keep some sort of order and cleanliness in one cottage after another, as the family moved on to a new mine along the banks of the Tyne.

Nevertheless, George had a good time growing up. Because the house was so small, the youngsters had to play out-of-doors. And George, as one of the older ones, had to see that none of his small brothers and sisters got in front of the coal wagons, drawn with such a clatter along the wooden tramway right in front of the cottage door. That was a busy job, but he found time—probably while carrying his father's dinner to the mine—to go bird's-nesting and to follow small animals scurrying back to hiding places among the bushes.

Of course he had to begin work just as soon as he could find any employer to take him. At first, he watched a widow's cow for twopence a day, spending long hours fashioning whistles from reeds, and, later, beginning, with small Bill Thirwall, to build clay engines. He led horses for men who plowed, he hoed turnips and had his day's wages increased to fourpence. Then he joined James, an older brother, at the mine, walking two miles to be paid sixpence for picking stones and dross from the coal and then eightpence for driving a gin horse. To his great joy, by the time he was fourteen his father managed to get him a job as assistant fireman at the magnificent wage of a shilling a day. In another

year he had his first independent job as a fireman in a new mine. Two years later he was back in the mine with his father. But as engineman, a job of more skill than any his father had ever had.

As part of his new work, he had to see that his engine performed at its best. If it did not, he had to find out why. That meant taking apart the fascinating machinery, repairing it, cleaning it. The memory of those days with Bill Thirwall and the clay engine had never left him. He now meant to find out all there was to be known about engines. To do that he had to learn to read. Up until then there had been neither money nor time for such things in the Stephenson family. Nobody could claim there was much more of either when George arrived at the age of eighteen and decided to find out for himself, as much as he could, what books said about engines. While he was at this reading business, he determined also to find out for himself how that exciting Napoleon Bonaparte was winning his astonishing victories for France, to say nothing of how to hatch birds' eggs with artificial heat.

Yes, there was an astonishing amount to be had from books at the close of the seventeen hundreds. So George Stephenson tracked off to the village night school three nights a week and paid threepence a week for learning to read and to write his own name. After that, he increased his tuition by a penny a week in order to study mathematics, carrying his sums back and forth on a slate, working every spare second he

could find, and doing well enough to make his schoolmaster boast of him.

Somewhere, somehow, about this time he learned to be a brakeman, and when only twenty was given a responsible job which took him away from home to live in a farmer's house. There he met Fanny Henderson; later he married her, and they went to housekeeping in a two-storied house with a small garden plot, half a dozen miles below Newcastle. In 1803, his son Robert was born. From that day life meant more, far more, to George Stephenson than ever before. Perhaps the relation between the two was all the more close because of the death of the boy's mother when he was a mere baby. By that time the family had moved to Killingworth, where George had another job as brakeman.

Shortly after his wife's death, he received an invitation to go to Montrose, Scotland, to supervise the workings of a Watt engine. After turning small Robert over to the care of a neighbor, he slung his kit across his back, walked to Scotland, stayed a year, saved about twenty-eight pounds, and then walked home. He was met with the news that his father had lost his eyesight from being severely burned with steam. It took over half of that twenty-eight pounds to pay his father's debts, to say nothing of what it cost him to set his parents up in a cottage near by and support them the rest of their lives. Fortunately, he soon became so well known for his skill in working

with old and broken engines that he was called the "engine doctor." After some half a dozen years of this service, he was made engine-wright at Killingworth High Pit, at one hundred pounds a year.

This meant he had not only more money but more time. Robert was sent into Newcastle to school, riding back and forth on a slow donkey, but getting home in plenty of time for his father to go over the boy's day eagerly. In the meantime, George Stephenson had been finding more and more use for his knoweldge of mechanics. By one device and another he reduced the labor of drawing coal from the mines and loading it. Gradually all the machinery of the mines near Killingworth came under his supervision. Then he tackled the problem of cutting the expense of hauling coal from the mines to ships. At that time the work was done, slowly and laboriously, by horses dragging wagons over tram-roads, largely wooden roads, as only a few iron ones had yet been used. Here and there a steam engine had been tried, but without success.

Stephenson studied those engines. He decided he could build a better one and proceeded to lay his plans before those in control of the Killingworth mines. One of those men, Lord Ravensworth, had been watching Stephenson for some time. He liked him. He felt sure of his work, so sure of it that he promised to finance the new engine.

But money was by no means the only difficulty in building that engine. There were very few skilled

mechanics in those days. Such tools as existed were heavy and awkward. But Stephenson knew no better ones. So he set up his shop and went to work. For ten months. At the end of that time, in July, 1814, his engine appeared on the Killingworth railway. Nobody could say much for its looks. However, it was coupled to a train of eight loaded coal wagons, and with a tremendous clatter and clang got off through a black cloud of its own smoke. And it kept going. But it could make only four miles an hour. And the cost of running it was but little less than horsepower.

No, not even George Stephenson could call that first traveling engine an exciting success. Still it was better than any others then existing. That was something. And George Stephenson, having learned much in its building, was already fairly bursting with plans for improving it. But while he worked on these plans, in fact all through the months while the first engine was taking shape, as well as through several years before that, he had been experimenting to make some sort of light for miners to carry safely along the dark subterranean passages where they worked. Disastrous fires, tragic loss of life, had been going on always, caused by the naked flame of the miner's lamp setting off the inflammable gases in the mines. Something had to be done.

After much thought and talk, Stephenson described to his friend, Nicholas Wood, a lamp he thought would be safe. Nicholas drew a plan. A firm in Newcastle

made a lamp from that plan. Stephenson and some friends descended into a mine where explosive gas was hissing angrily through a blower in a corridor roof. Insisting that his companions stay far back, at as safe a distance as the mine would permit, Stephenson went ahead by himself and held the lamp directly in the path of the angry current of gas. The flame flickered, went out, was relighted. There was no explosion.

Not in the mine. But when the news of George Stephenson's invention reached the outside world, an explosion of ridicule, of denial of its worth, broke forth with a vengeance. For, by some strange trick of fortune, Sir Humphry Davy, a noted scientist, about the time Stephenson had made his experiment and proved his lamp safe, had come forth in the midst of his brilliant circle with another lamp—apparently a lamp of equal safety. Of course, Sir Humphry had the scientific world behind him. Equally, of course, Stephenson did not. In fact his lamp had been thought out and made without his having any access whatever to the resources of science. Each of the men had worked independently. Neither had any idea that the other was working on the same invention. Each, therefore, deserved credit. As a sign of approval, Sir Humphry was presented with two thousand pounds, while Stephenson was voted a few hundred for his contribution.

Immediately Stephenson's friends rose in protest and insisted that Stephenson publish a statement concerning his work on the lamp. Finally, Stephenson dictated

one page of facts to Robert. This, published in a Newcastle paper, together with a pamphlet issued later, covered his defense. His friends, however, were not content. They raised a thousand pounds and presented it to him. But what George Stephenson prized even more than those English pounds was a silver watch which his friends, who worked in the mines and whose lives he had safeguarded with his lamp, gave to him.

In the meantime, Stephenson was not at all satisfied with his clumsy awkward engine chugging along in the Killingworth tramway at four miles an hour. As he worked to improve it, he concluded that, while his engine was full of faults, the road on which it ran was also to blame. So he began experimenting on that, and by 1816 secured a patent on his invention to improve the rails of the tramway. The money for this work was furnished by Mr. Losh, a rich iron manufacturer. At the same time he guaranteed Stephenson a set income of one hundred pounds a year and a share in all profits arising from his inventions providing he—Stephenson—would work two days a week at the Walker iron works. With his new connection, with more money even if he had less time, Stephenson completed an improved locomotive, set it upon the new rails, and stood back with his friends to see it make good all he had claimed for it.

But again his group cheered pretty much alone, and rather ineffectively. After all, Stephenson was a man of

small learning, a miner living far off from the centers where men of science dazzled the world by brilliant discoveries. So, as in the case of Sir Humphry Davy and his safety lamp, another engine, known as the Blenkinsop model, the product of an educated man, caught and held the public eye, although those who saw both declared Stephenson's to be more trimly built and more effective in work.

About that time he was asked to go to Durham County to act as engineer in laying an eight-mile locomotive railroad. The route lay across one of the highest hills in that part of England. But Stephenson completed it by 1822, and while people crowded close to the rails and craned their necks in wonder, he set not only one but five of his locomotives to work, each hauling seventeen wagons of coal. And they kept on hauling, this time to win a little more grateful attention, since they were meeting a crying need in getting coal from the mines to ships lying down in the harbors.

A year before this achievement brought recognition to Stephenson, he and his friend, Nicholas Wood, had traveled to Darlington, to call on Edward Pease, whose bill for a railroad between Stockton and Darlington had just passed Parliament. Nothing was being said by Pease and his company about locomotives. All the men argued for was the advantage of railroads over the old wooden tramways, railroads operated by horse-power. Stephenson wanted to build that road. Incidentally, during his call, he startled Edward Pease by

announcing that the locomotive engine then in use on the Killingworth railway saved the use of fifty horses. The discussion of that together with plans for the new road took so long that the two Killingworth men missed the coach and had to walk the eighteen miles home.

But Pease liked Stephenson. Afterwards, when he inquired about his work, he came to like him better. He recommended him to his company. And, as a result, Stephenson was asked to begin a survey for the new road. Immediately, Stephenson chose his assistants and started the work. Since nobody, in those days, knew much about surveying, he felt his responsibility keenly. Nevertheless, even while so occupied, anyone knowing George Stephenson would be sure that he never could picture a railroad for long without placing a locomotive on it. There was his very first call on Pease to prove that. With the road actually taking shape, he could not possibly refrain from discussing engines. Would Pease go over to Killingworth to see the one there in action? Yes, Pease thought he would. So off he and another member of the company went to be bundled onto the train of coal wagons and experience for themselves the ease of traveling by rail. Then he went back to secure the insertion of a clause, suggested by Stephenson, to amend the Stockton and Darlington Act, giving his company power to use locomotives to haul both passengers and products.

If Stephenson rejoiced over that—the first act of Parliament permitting the use of engines for passenger

travel—he was not the sort to spend much time doing so. Instead, he began to plan for some way to furnish the engines he now saw would be needed. He still had the money given him by the Killingworth coal owners for his work on the safety lamp. Pease and a friend each agreed to add five hundred pounds. In 1823, a site for a manufactory was bought in Newcastle. By the next year, the new plant was in operation.

The following year, September, 1825, saw the opening of the new road. In place of the cast-iron rails at first determined upon by the company, Stephenson had been able to get them to substitute wrought-iron ones for half the way. Of course, he had wanted wrought iron for them all. But since his suggestion would cost the road over twice the amount set apart for cast-iron rails, he had had to be satisfied. At any rate, he had won a complete victory for his locomotive engines, the directors having ordered three to be ready for the opening.

On the day of the opening, people came in droves from Newcastle, Durham, the whole countryside. Darlington and Stockton took a full holiday. The procession began to form out at the mines near Darlington, at six in the morning, with George Stephenson acting as engineer, heading a train of six cars loaded with coal and merchandise, a covered coach carrying the directors and proprietors of the road, twenty-one more covered coaches crowded to spilling with people, and at the end half a dozen wagons heaped up with coal. Right in front of Stephenson's engine rode a man on horseback

carrying the company's banner, apparently having not the slightest fear that he stood in any danger of being run over by the snorting iron horse coming along at from four to six miles an hour. Suddenly, however, Stephenson shouted to the rider to get out of the way. Then to the terror of the spectators he put on steam and raced ahead at the mad speed of fifteen miles an hour.

All this happened along the way from the mines before the train reached Darlington. At that point the last six coal wagons were abandoned and one hundred and fifty passengers, together with a band, were taken on. Then began the main trip—twelve miles to Stockton—made in three hours. The directors of the company looked at each other dazed. They had dared hope for a moderate success, but that trip was beyond their wildest dreams. And those of the succeeding year heaped so high their profit and fame that no man among them could believe his good fortune.

At first no one, not even Stephenson, had given much thought to transporting passengers. Coal and other local products needed to be hauled from point to point, needed to reach the ships sailing to far-off lands. But why should men want to travel about? And if they did there were the stagecoaches running in many parts of the island as often as three times a week. But that breath-taking fifteen-mile spurt of Stephenson's engine had stirred the blood of directors and passengers alike on that September day of 1825. Stephenson was

therefore authorized to begin building passenger coaches. The first one looked more like a circus wagon than anything else. Stephenson wisely called it "Experiment."

Now, as so often happened with this miner of Newcastle, while carrying out one project mighty enough to occupy fully any ordinary man's mind and time, he was also deeply engrossed in another piece of work, even mightier in its scope than that of getting a train running between Darlington and Stockton. That work was nothing more or less than getting another train running between Liverpool and Manchester. The bill concerning this road had been presented to a Parliamentary committee in the spring of 1825. And Stephenson, who had been busy surveying the route for several months, was brought before the committee to tell why he thought the project possible. Nobody else did. There was Chat Moss, a twelve-mile peat bog lying along the direct route between Liverpool and Manchester. It would be necessary, according to the survey he had made, to construct sixty-three bridges. There would also have to be a two-mile cut through the sandstone of Olive Mount, a viaduct over a deep valley, to say nothing of a one-and-a-half mile tunnel under Liverpool itself.

Any one of these tasks called for an engineering skill not yet existing so far as that learned committee knew. What was this miner from Killingworth thinking about? Still further, what was he trying to say in his queer Northumbrian dialect? Nobody could understand half

of it. What they did catch here and there they jeered at as utter nonsense. But even so they kept the unlettered miner before the committee three days. After that they cross-examined him as if he were trying to do some wrong. On top of all that the bill was thrown out by the committee. The directors, still determined, however, to go ahead, hired the most experienced and famous engineers they could find to go on with the work of surveying Stephenson had started. Finally when everybody was worn out with the struggle, despite a storm of protest from property owners, the bill was presented again. This time it passed.

And then, George Stephenson, in whom some of the directors had never lost faith, was appointed chief engineer at a salary of one thousand pounds a year. He moved to Liverpool. He started, without wasting a day, on the task sneered at as a job only for a man out of his senses, a job that took five years. But in the end the bog had been crossed just as Stephenson had promised it would be. The bridges had been built. The cut had been made and the tunnel under Liverpool had become a fact. All this meant that the railway had been built from Liverpool to Manchester very much as the Parliamentary committee of years before had heard the Killingworth miner say it could be.

The opening was set for September 15, 1830, with eight snorting, belching, fearful-looking engines from the miner's own plant in Newcastle ready to show how fast they could run from seaport city to inland town.

There were also railway carriages waiting to carry at least six hundred people along the way. The great Duke of Wellington, then Prime Minister of the Empire, was present to see if what he had been hearing could be true. Sir Robert Peel, former Home Secretary, had come along. So had thousands of others, some great, some just plain people. George Stephenson sat in the first engine, his son Robert in the second, and his brother in the third. Following were men who had worked with George Stephenson in building the road. At last the procession got off amid tremendous cheering, off through the Liverpool tunnel, through the cut of Olive Mount, across bleak Chat Moss—and into Manchester, where the cheering roared to the very heavens above.

And after that? Well, of course, for one thing everybody soon forgot there had ever been any question of the practical use of railroads. George Stephenson, himself, was made engineer of at least four reaching out from the center of England to the coast. Across the Channel, Belgium heard of his work and sent for him to advise their men in the building of railways. Spain did the same. At home, he was much in demand by the Mechanics' Institute. And in meeting that demand he conquered his Northumbrian dialect sufficiently to become a good speaker—a speaker who could always be counted on to say something worth hearing.

While working on his Midland railways, his men had discovered coal. In the negotiations that followed,

Stephenson leased considerable land. Tapton House, near Chesterfield, a brick mansion looking across quiet fields and woods to the Derbyshire Hills in the distance, was included in his lease. There he took up his home. From there he went forth to direct his coal mines, to visit his locomotive works at Newcastle, and to see that his many improvements were being added to the engines there. Gradually he turned his activities over to Robert, the son who had stood so close to him through many struggling years, and who was now a famous engineer himself.

For, as George Stephenson neared the close of his life, his many and full years of living, he seemed to think he had earned his right to do some of the things he had always wanted to do. He still kept up his interest in railways, he still turned back to his old friends in the collieries, still worked for their greater ease in living. But he found his greatest delight in the gardens and fields and woods of Tapton House. There he raised marvelous melons and cucumbers, grew strange new plants, had herds of fine stock and a bewildering lot of pets—birds and animals of all sorts. Old Killingworth friends were always welcome to come and stay as long as they liked with him. New friends came also—great men of England—who went away refreshed from their visit with the man who kept so vitally alive with his simple interests and his long range of vision across the world.

So he lived on, lived to be sixty-seven before an attack of intermittent fever ended his life. The whole

world of science paused at his passing. Around Newcastle men stopped each other to recall the days they had worked with him. Statues were erected to his memory. So were bridges. Among them all George Stephenson would have liked most the statue in the Northwestern Station, Euston Square, London, toward whose building three thousand one hundred and fifty working men each contributed two shillings.

Robert Fulton

In the meantime, eighteen years before the September of 1825 when George Stephenson drove his first engine along the Stockton and Darlington road, Robert Fulton, a tall, slender, handsome American, had steered his queer-looking craft, the *Clermont*, one hundred and fifty miles up the Hudson, one hundred and fifty miles back, at the rate of about five miles an hour, with a head wind making such sails as she had useless, but with a steam engine somewhere down in her middle furnishing power for her miraculous journey.

Robert Fulton was then forty-two. He had been sixteen the year George Stephenson was born. During those sixteen years—1765 to 1781—the thirteen very young, very sure British colonies had risen in their might, fought the Revolution, and were rather floundering about to get themselves united in a new Republic. Certainly blood-stirring years for any American lad to be growing up. For one born, as Robert Fulton was,

of a family from Kilkenny, Ireland, and living in Lancaster, Pennsylvania, where two thousand British troops strutted arrogantly about during the Revolution —for such a boy life certainly held plenty of color, and plenty of action.

Robert was the son of another Robert Fulton who married a Mary Smith. After living for a time in Lancaster, the couple bought a farm of nearly four hundred acres in Lancaster County, and moved into a plastered stone farmhouse there, just a year before Robert was born. But apparently the Fultons were not good farmers. So the very next year they moved back to Lancaster.

There, as the boy grew, his mother taught him to read and write. At eight, he was sent to a school where his Quaker-Tory master managed by use of the rod and other measures to give him about all the formal education he was ever to have. For even in those early years, Robert Fulton was called "Quicksilver Bob" because of his swift sliding from one interest to another, especially those having to do with firearms. Very likely this last attraction was due to his being made so welcome to the Lancaster shop of Isch and Messersmith, where arms of all sorts were made and repaired.

Another interest of his was developed from meeting, in the same shop, eighteen-year-old Christopher Gumpf, an apprentice, whose father was a fisherman. The father often took the two boys with him to help him pole his flat-bottomed boat along Conestoga Creek. The work

was not easy. Perhaps that is why Robert began experimenting with paddles and wheels to be used in place of poles. At any rate, by the time he was fourteen he had fitted the Gumpf boat with paddle wheels moved by a double crank and had them acting well enough to be used in all fishing trips he and Christopher took.

While apparently absorbed in this tinkering with firearms and boats, Robert Fulton was also painting signs, drawing caricatures of the Hessian soldiers, and listening to his father talk of Benjamin West, an artist, a neighbor of earlier years, who had gone off to Philadelphia and New York to earn fame and fortune by painting portraits. "Why," so Robert's father said, "before he had been there many years he was receiving as much as five guineas for one full-length portrait!"

That was enough for young Robert. If Benjamin West could do that by painting, he could, at least, earn his living. By the time he was seventeen, therefore, he was in Philadelphia. Once there, he painted portraits and miniatures. He drew designs for ship machinery, for carriages, and buildings. He earned enough money to pay his own way, to send some home, to buy a farm and four lots in Washington. And in doing so, he broke his health and had to go to Virginia Springs. There he made friends who insisted he ought to go to England to study art.

Well, why not? There was Benjamin Franklin, attracted by the young man's never-ending energy, ready to introduce him to men of influence abroad.

There was Benjamin West, his father's old friend, painting in London. It did not take long for Robert Fulton to accept his friends' advice. He sailed for England in 1786. At that time George Stephenson, a five-year-old youngster, was spending his days trying to keep out from under the horse-drawn coal cars, clattering along the tramway in front of his father's drab cottage near Newcastle. Robert Fulton spent his time working endlessly, living in West's home, getting along well enough as an artist to gain some recognition from the Royal Academy and to have paintings exhibited at the Society of Artists.

But there was that boyhood interest in mechanics still lingering in his memory. On a trip from London, he met the Duke of Bridgewater, who had opened a canal for carrying coal from mines under his land to Manchester, and who was piling up a fortune through his connection with several navigation companies which were then building a system of waterways throughout England. He also met, on the same trip, the Earl of Stanhope, who was busily at work trying to perfect an invention for steam navigation, an invention which involved a paddle, looking like nothing quite so much as a duck's webbed foot. After that, Fulton went on to Birmingham to study canal possibilities and to hear much about the steam engines of James Watt.

Because of all this, by 1793, seven years after landing in England, art had become a minor interest to Robert

Fulton. After that, his whole attention was apparently given to mechanical devices of one sort or another. The British government granted him a patent for his invention for raising and lowering boats; another for a machine to be used in dredging; then, later, for a market or passage boat; and still later for a dispatch boat. By 1796, he published *A Treatise on Canal Navigation,* in which he showed that he could be as clever in writing as, judging from his plates in the same works, he was accurate in his drawing.

About this time, the young Republic of America, very anxious to build up her overseas trade, found British seamen interfering with her progress by seizing her ships and men. Robert Fulton resolved to do something for his own government. So he crossed to France, took up his home with Joel Barlow, American poet and diplomat living in Paris, and began work on his invention of a submarine torpedo by which he hoped to destroy all sea armaments, and thus bring security, not only to American ships, but to all ships that sailed the seas. At the same time he also began work on a Panorama which he completed in 1800 and which was the first ever shown in Paris.

Reasoning that since he was working for universal peace France as well as the whole world would benefit from his invention, he appealed to the French government for help in building his first torpedo. That government kept him dangling along for months, never giving him full approval, before the British government

asked him to return and present his plans to it. He did so. He worked two years, against great difficulties. Then came a change in the ministry and the interest of the British government lessened in his plans.

Discouraged, Robert Fulton returned to America. Twenty years earlier he had left his own land, a young artist, full of dreams of what the Old World galleries held for him. He came back a man of middle age—those dreams more or less forgotten and others not realized. Even so, he does not seem to have lost heart, then or ever, for any length of time. His mind was so full of ideas he wanted to test that it was impossible for him not to get busy with some one or other of them. For instance, there was the idea about supplying boats with a surer, swifter power than those of wind-blown sails or man-propelled oars, the one he had begun to test along the Conestoga, years before, in Gumpf's fishing boat.

Now that he found himself free, he decided to see what he could do about increasing the ease of running an ordinary boat. The time was certainly ripe for such an attempt. Over in Scotland and France, as far back as 1781, more or less successful trials had been made for propelling boats with steam. Then there had been that queer web-footed paddle of the Earl of Stanhope in England. In his own land others were interested along the same line.

Among these last was Robert Livingston, stationed in Paris as United States Minister to France while

Fulton was there. As early as October, 1812, the two, Fulton and Livingston, by that time understanding friends, had entered into an agreement with each other to construct a steamboat guaranteed to run between New York and Albany at the rate of four to eight miles an hour and to carry sixty passengers. But even with those plans made, Fulton had then been too occupied with his torpedo to return to America.

Still there were all those designs for a steamship, so he and Livingston entered into a partnership for building one on the Seine River. Plans were made, a steam engine rented, and the boat was near completion when suddenly it broke—broke through the middle and dumped the engine into the Seine. For twenty-four hours, without stopping for rest or food, Fulton worked madly to rescue his precious machinery, and then to begin all over again to build his ship. This time he succeeded so well that in July, 1803, curious Parisians—famous scientists and common people alike—crowded the river bank to see his boat traveling by at the unheard-of speed of six miles an hour.

With that success granted his trial on the Seine, Fulton crossed over to England to take up negotiations concerning his torpedo and to order a Bouton and Watt engine for use in the boat he and Livingston were planning to build in America. There was trouble at first in getting permission—later granted—to ship the engine. There was greater trouble for Fulton when the British, at last, definitely refused to go on with his torpedo.

At any rate, even if he was disappointed by that refusal, he was then free to return to America, offer the invention to his government, and begin to construct the steamboat on the Hudson. That was in midwinter, 1806. And the Atlantic crossing took him two months. Did he fret and fume over the waste of time? Or did he comfort himself by contrasting that slow sailing vessel with visions of his own steam-propelled one cutting swiftly through the wide stretch of water?

Whatever he thought, he traveled on to take up his home with Joel Barlow, who had returned from Paris to live near Washington. He offered his torpedo to President Jefferson and successfully demonstrated its power by blowing up a brig in New York harbor. That happened in July, 1807. In the meantime, he had been busy all that late winter, spring, and summer in the shipyards of the East River, New York, building the boat he and Livingston had planned five years before. Old seamen along the shore called the ship "Fulton's Folly," but he and Livingston called it the *Clermont* after Livingston's home of that name.

Such a lack of faith in his projects was by then accepted as a matter of course by Fulton. But when he was threatened—only a few weeks before the ship's completion—by a lack of funds to finish the "Folly," well, that was another matter. With great trouble, he managed to raise a thousand dollars among his friends, promising not to expose them to ridicule by letting the public know they had been foolish enough to

spend money on such a mad venture as he was backing.

With that thousand dollars, Fulton completed his boat, and got it around to a dock in the North River in time to begin his first scheduled trip up the Hudson on August 17, 1807. It was a queer, awkward-looking craft, with all of its machinery standing out in plain sight in the center, with the bow and stern covered for cabins, with its paddle wheels swinging ponderously alongside, and with a fearful amount of smoke billowing out from the wood fire burning somewhere below decks. Of course there was a crowd on shore, a crowd somewhat impressed but ready to break forth in hoots of derision the second the belching creation failed to do what Fulton had promised. On board, those who had gathered to make the trip, friends of Fulton and Livingston, looked at each other uneasily.

At one o'clock, a horn blew. There was no such thing as a steam whistle on the boat then or for many a day thereafter. The ship heaved forward. Then stopped. The passengers caught their breath, and held it. Then Fulton appeared, to call out to the crowd, asking them to be patient for half an hour. If he could not adjust the difficulty in that time they could go home. As everybody knows, he did adjust it and, almost before the ridiculing people on shore knew what was happening, the boat was moving up the river, this time to keep right on moving, except for stopping at wharves here and there for additional wood to keep her fires going. Traveling the

rest of that day, and on through the night, the passengers sleeping on any sort of makeshift beds and groping about by the light of candles, it reached Albany thirty-two hours after leaving the New York dock.

The success of that first trip of the *Clermont* marked the high point of Robert Fulton's public achievements, and the high point of happiness in his private life. For on that first day's exciting trip up the Hudson, he became engaged to Harriet Livingston, a relative of Fulton's famous partner and a girl sufficiently gifted in music and art, sufficiently wealthy, sufficiently poised, to hold her place as the wife of a man famous both at home and abroad.

And Fulton needed all the steadying qualities Harriet Livingston could bring him. By 1810–1811, fourteen years before Stephenson made his first trip from Stockton to Darlington, he had completed a plan for a steam railway. But he pushed it aside—temporarily—when Livingston voted it impractical, and went ahead building boats. Seventeen of them, including a steam war frigate and a steam ferryboat. During most of this time he was distracted by charges that he had infringed the rights of others in his numerous patents—those old, old charges that always spring up to destroy the satisfaction of a man in his successful inventions. In addition, there were legal contests over the use of his boats in other waters except those owned by New York. These last must have caused Fulton to smile rather bitterly, as his own great hope for his boats had always been to see

them carrying people and products of trade along all the great rivers of America.

Perhaps that is why he had no thought for his own life and health when summoned to testify before the New Jersey legislature at the time an appeal was being made to repeal laws which curtailed the use of his boats. It was winter when that summons came. The hall at Trenton was poorly heated. On the way back, the boat was halted several hours by ice in the river. Before recovering fully from that day's exposure, he went to superintend the work on his frigate and stayed out for hours in miserable weather. Even so he might have withstood that shock if it had not been for the breakdown due to his first hard-working Philadelphia years, or for the exposure of that twenty-four hours on the Seine when he had worked like a madman to save his first boat.

For he was only fifty years old that winter. Not an old man in years, and certainly not through with trying out even a small part of the ideas his vivid mind had been heaping up since his boyhood days in old Lancaster. Nevertheless he had lived fully. He had spent his strength without stint. He had nothing left with which to fight.

When the end came, February 24, 1815, national, state, and city officials gathered to do him honor. As the procession moved out from his home at No. 1 State Street, toward Old Trinity, guns boomed forth from steam frigates stationed down in the bay and were

answered by others from West Battery. Today he lies in quiet old Trinity churchyard at the head of Wall Street. Near by, Fulton Street cuts across from the East River to the North River and the hoarse whistles of his ferryboats echo ceaselessly as they put out from the Battery.

While Watt, Stephenson, Fulton, and their fellows were spending their whole lives with engines on land and water, other men were spending theirs wondering just how long it would be before the clatter of locomotives along street rails, the swish of steamboats along the world's waterways, would be silenced by the roar of flying machines cutting through the heavens with miraculous speed. For thousands of years before land and water travel had begun to reach out to connect distant peoples and countries, men had dreamed of flying. There is an ancient myth of Daedalus, who sends his son, Icarus, flying off through the heavens with wings held together with wax. And there is the ending also, when Icarus dared to draw so near to the sun that the wax melted and he came tumbling, hurtling down.

By 250 B.C., Archimedes, the great Greek mathematician, had figured out practical principles for flying and set them down so accurately that men still marvel at them. A thousand years later, Roger Bacon seriously considered how to make a machine that would fly. Then in one century after another, one man here, another there, experimented with kites and balloons. At last in

the closing years of the eighteen hundreds, men of science began to experiment with heavier-than-air machines. And Alfred Tennyson, with his poet's power of prophecy, wrote:

> For I dipt into the future, far as human eye could
>   see,
> Saw the Vision of the world, and all the wonder
>   that would be;
> Saw the heavens fill with commerce, argosies of
>   magic sails,
> Pilots of the purple twilight, dropping down with
>   costly bales;
> Heard the heavens fill with shouting, and there
>   rain'd a ghastly dew
> From the nations' airy navies grappling in the
>   central blue.*

The Wright Brothers

And then after thousands of years of such dreams, such tinkerings with what most of the world looked upon as wild fancies; far off from old Greece; far off, in fact, from all the Old World; out in the heart of America, two boys, ordinary healthy New World boys, without any background of science, without influence of any sort, without money, set out to turn those age-old dreams into practical, everyday means of traveling by air. They were not poets. They were not dreamers. They were just unusually curious American boys who

* "Locksley Hall," Alfred Tennyson.

wanted to know—always—the secret behind any piece of mechanical action. Once knowing that, they had the habit of figuring out how other developments might grow out of that secret.

Of course, as all the world knows now, those boys were Wilbur and Orville Wright, sons of Milton Wright, a United Brethren minister of good old Puritan Massachusetts stock, and Catherine Koerner Wright, of equally staunch German descent. Those two had met as students at Hartsville College, Indiana, and had carried over into their home a taste for books and other fine things of life which their children grew up to accept and share.

But the Wright house was never the quiet one usually pictured as belonging to a book-loving minister's family. There was the father going out to travel far and wide, thousands of miles in fact, up and down the mid-western prairies. There was the moving whenever that father was sent from one church to another. Wilbur was born near Millville, Indiana, in 1867. Shortly after, his father was elected editor of the official periodical of his church, and that work carried the family off to Dayton, Ohio. There Orville was born, in 1871. When Orville was seven his father was given a church in Cedar Rapids, Iowa, and the Wrights found themselves crossing the Mississippi to settle down for only three years before moving east again, first as far as Richmond, Indiana, and then in another three years, back to Dayton.

Orville and Wilbur Wright

And there they settled down to stay. The father had been made a bishop seven years before. His salary had risen above the $200 a year he had received when he and Catherine Koerner were married, but at the highest it never went beyond $1,500 annually. But Milton and Catherine Wright were thrifty people. Out of that income—plus the thousand dollars they had received as a wedding gift from their parents—they managed to live, to buy a farm of Iowa land and a home in Dayton, and build up a sense of security for themselves.

No doubt that thriftiness was largely the result of the rather unusual balance of spiritual, cultural, and plain common-sense qualities always found in the Wright family. There was their library of about two thousand volumes—not a usual thing in a modest midwestern home of those days. There was the matter-of-fact acceptance of loyalty to one's religion, one's friends, and one's family. But what was to be of far more significant value to the world than any of these influences was the mother's and father's deftness in handling all sorts of mechanical devices that came into the house—that and their unfailing interest in anything constructive their four children—Reuchlin, Lorin, Wilbur, Orville, and Katharine—attempted to do.

And those children attempted plenty. Especially Wilbur and Orville, who were always planning together, reading together, tearing apart their toys to see how they were made, or flying kites and playing ball on the level commons of Dayton's West Side. And all the time,

in between those many activities, they were tinkering away to find out why the small toy flying machine they made did not fly as easily as the one which their father had brought home to them in Cedar Rapids. Or, for that matter, like the first one they themselves had modeled exactly after their father's gift. It was a teasing thing—that secret of flying, even in a toy which only circled the family living room before buzzing down ignominiously.

Finally, because they were getting nowhere in solving that secret, they stowed its possibilities away for a time. Wilbur, when the family returned to Dayton, was ready for his fourth year in high school and was busily working every spare hour to earn money to help himself through Yale. And then one day, while playing shinny, he was struck a terrible blow in the mouth. Besides breaking his teeth and causing him an agony of suffering, the shock left him broken in health.

Yale was out of the question, as was pretty much everything else outside of the four walls of his home throughout the next four years. But within those walls he managed to do much. There was his mother, who had developed tuberculosis—slow consumption they called it then—and was therefore also an invalid. The two read together. They worked at all sorts of mechanical contrivances. Wilbur grew stronger but his mother grew weaker. He nursed her with remarkable gentleness and skill. No one then, however, knew much of what to do with suffering like hers and she died just as Wilbur was ready to begin life again.

Fortunately, Orville had a place ready for him. Rather he and Ed Sines had. Ed was a neighbor boy living a few blocks from the Wrights, who shared the neighborhood kite-flying, ball-playing days of Wilbur and Orville. He liked them and they liked him. When Wilbur's accident took him out of all outdoor activities, Orville shared his days more and more with Ed, who, to add to his other attractions, possessed a set of rubber type and an inking pad. Absorbed, he and Ed Sines spent hours experimenting with that type. Bishop Wright watched them. They seemed to be getting somewhere, so he bought them a twenty-five pound font of type.

With that in front of them the two boys felt the world was theirs. Orville suggested they build a printing press. Ed agreed. They found an old gravestone and a roller. They gathered together some two by fours. Out of these articles they produced a press which could turn out simple printed sheets much faster than other presses then in use in their community. Their first job brought them two dollars. That was exciting enough, but not half so much so as the plans which the two immediately began to make for publishing a newspaper. At the same time they continued their job printing, and Orville built a new press.

By that time it was 1889, and Wilbur was well enough to work again. Bishop Wright was ready to turn over to him and Orville their share in the family property. Although the boys did not use that small capital then,

they did take over the directing of the printing business, with Ed Sines continuing to work for them. It was about then that they began to put out the first issue of *The West Side News*, a four-page, four-column, weekly paper, with Wilbur as editor, Orville as publisher, and all three boys distributing it to about four hundred subscribers. With that venture, Orville, who had continued in school until then, doing his printing at night and on Saturdays, gave up trying to do both, and school lost before the pressure of the printing business. Later, an evening daily was tried and failed. Then a weekly magazine—*Snapshots*—with Wilbur furnishing most of the copy was started and kept going to make them money.

Those were the years when the bicycle was first taking possession of men's minds. By 1893, everybody who could possibly scrape money enough together was buying one. The two Wright boys, looking on, decided that if bicycles were to be ridden, there would be need of shops to sell them and to repair them, and maybe—some time—factories for making new models. So they set up a bicycle repair shop across the street from their printing office. In three years the bicycle shop was far outstripping the printing shop in income.

Then, one day in 1896, Wilbur read of a German, Otto Lilienthal, who while trying to fly with a big kite had fallen and been killed. He had been eighteen yards from the ground. Having reached that height, why had he not been able to go farther? Or to get down to earth again safely? Wilbur looked at Orville, who stared

back at his brother. Across a score of years there came to both a picture of the "bat," that queer little bright-colored toy flying machine, buzzing across the old Cedar Rapids living room. Then came memories of those days and days of trying to build one that would go up and stay up. Of course they had never really forgotten that work. Now they took it up again with all the pent-up enthusiasm of the years between.

They studied everything they could lay hands on from Archimedes to Lilienthal. They spent hours, whole days—and many of them—watching the flying of birds and studying the effect of air currents on that flying. They wrote to those who were working on the same problem. They read with intense interest, as did Bishop Wright and their sister Katharine, of experiments made in gliding. They kept this up for four years. At last, in 1900, they decided they were ready to try again to solve the secret of flying.

They wrote to the United States Weather Bureau asking to be told of a place where the wind blew with a "fairly constant but moderate velocity." The Bureau answered that Kitty Hawk, North Carolina, on Albemarle Sound, was such a place. That answer came in late summer—as good a time as any to see whether their years of study could show practical results.

That decided, they took the long trip—by land and water—to Kitty Hawk, which they found bleak, barren, and forsaken enough to promise them any length of uninterrupted days to build their first glider. Early

in October they had the machine finished and ready to try. Neither of the men knew anything about controlling the machine. But there they were. And there their machine was, looking more like a huge white kite than anything else. One of them—nobody seems to be sure which—climbed in. The other released the machine. It lifted easily. It was hauled down as easily. That trial was followed by others from a steeper hillside down which the machine slid on currents of air to land without disaster.

Encouraged but far from satisfied, they then went back home to rebuild on what they had learned and returned to Kitty Hawk the next fall, to hear Chanute, a Frenchman with years of experimenting in flying behind him, who had been watching their work, tell them that they had accomplished more for flying than anyone up to that time had done. That was rare recognition. It startled the Wrights. Up to then they had looked upon their efforts at flying as something that, if successful, would add to the sporting resources of the world. By the time, however, they were back in Dayton, they knew they could never escape the responsibility lying behind the Frenchman's quiet acceptance of what they had done. Having come so far, they must go on.

That winter they set up a tube in their Dayton shop, at one end of which they kept a fan whirling, while at the other end they watched the reaction of thin sheets of cardboard or steel to varying wind pressure. By the

time they were ready to return to Kitty Hawk the next fall they had accumulated an entire new bundle of facts. The conclusion they had come to in connection with those facts led them to build a new glider, this time with a tail. That glider took them up not once or twice but a thousand times those bleak fall days of 1902, carried them, once, a distance of 622 feet, stood at a halt of as much as thirty seconds in the air from time to time, and held fairly well against winds of widely differing strength.

When the Wrights finally locked their shed doors that fall they knew they were ready to stop experimenting with gliders and begin working on a power plane. Back in their Dayton shop they faced the fact that such a motor, such propelling power as they had in mind, did not exist. So they set about building and testing their own motor. That was the year they gave up the bicycle shop. It was also the year they applied for service patents to cover their flying inventions, and the year that ended with Bishop Wright's handing them a dollar —when they started again for Kitty Hawk—to pay for a telegram telling him the result of the new machine's trial. Both he and Katharine were very certain that the news would be good.

Wilbur and Orville hoped it would be. Sometimes, however, in the weeks that followed they must have thought of their father's dollar with sinking hearts. To begin with, the year's storms had blown their shed off its foundations. They built a new one, and then

fairly held the tar paper roof in place before the worst wind of years exhausted itself across the barren hills of Kitty Hawk. After that they started to assemble the parts of the new machine, only to find flaws in a propeller. Orville traveled back all the long roundabout way to Dayton to make a new set of shafts. And then when the machine was finally completed, the weather became impossible.

It was December 14, 1903, before the two men stood by the machine flipping a coin to see who should pilot it on its first flight. Wilbur won. Near by stood five men who had tramped across the stubble and sand from their life-saving station a mile away to watch the test. They saw the machine run along the monorail down the hill slope for forty feet, lift steeply, go ahead 105 feet, and then drop to the ground. It had been up three and a half seconds. Despite the fact that the landing had broken several parts, the Wrights were elated. They had proved to their own satisfaction that they could get a machine into the air by the power they had built.

Three days later, at 10:30 in the morning, they had the broken parts mended and a track laid on a level stretch of ground. The friends from the life-saving station were again assembled, and Orville took his place in the machine. Would it lift from that level stretch? Would it stay up? It did both. And on top of that, after twelve seconds in the air it landed easily and safely at a point no lower than the one from which it had risen. The brothers, taking turns, made a second, a third, and

a fourth test, increasing the distance and time of each trip until the last set a record of 852 feet traveled in 59 seconds.

It was then, while they were standing beside the machine talking excitedly after that last trial, that a staggering gust of wind suddenly struck the machine, toppled it on its side, and sent it rolling over and over. When the men finally caught up with it, they found it so badly damaged that they knew all hope of further flying was over for that year. Nevertheless, they knew they had won. And they sent Bishop Wright his wire. Then they shipped the damaged machine to Dayton, followed it, and immediately began working on a new one.

In the meantime, what was the world thinking of Kitty Hawk, of the Wrights, of man's chances of flying? Not very much, and that much not very favorable. Many scientists voted it all stuff and nonsense. And to add to their verdict there was the disaster that had overtaken Professor Samuel P. Langley, who, after working for years in collaboration with the Smithsonian Institution and after the United States government had granted him $50,000 to develop his theories in flying, had found those theories completely upset along with his machine, which toppled into the Potomac —toppled as soon as it lifted from shore.

All this had happened the same autumn of 1903 that Wilbur and Orville Wright were trying out their home-made motor and sending their father the message of good news. Outside of that wire the brothers kept their

own counsel, just as they had always kept it. But a reporter on the *Virginia Pilot,* nosing about the Kitty Hawk region, smelled out what he thought was a good story and sent it off to his own and other papers the evening of December 17. The next day it appeared in eight dailies. Even then not much attention seems to have been paid to it. Shortly afterwards the British government approached the Wrights with propositions to buy their planes and patents. But the Wrights were staunch Americans. If their planes were what they believed they were—and what the British seemed also to believe—then America should have her chance at them first. They were, however, not quite ready to offer her that chance.

They spent 1904 getting ready. Since, by then, they had put about all they had into their flying ventures, they accepted a field for their experiments from a Dayton man who owned a level stretch of land about eight miles from town. That winter they built a new machine, improved somewhat in strength and power, which they tried in their new field the next spring. It was then that the Wrights really began to fly. Today, one wonders how they did, for not only had they to build and improve their machine without a model, except such as they set up through principles worked out by themselves, but they had also to learn, all alone, how to take advantage of air currents, how to use the power of their own motor, how, in short, to pilot their machine.

Nevertheless before that summer was over, they were flying over a mile at a time and remaining in the air for minutes instead of seconds. The next year, they were making six-mile flights. They decided then to risk the $5,000 that their father had given them years before, and to offer their patents to the United States War Department. While waiting for a reply they took out their 1905 machine and, as crowds stood gaping below, as farmers stopped in their fields, they circled overhead for 24 miles, at the rate of 38 miles an hour. Even in the face of what they had already done, the government at Washington refused to have anything to do with them. Even their own townsmen looked at them askance, as if not quite sure whether they were well balanced. With their whole small capital invested in the project, they saw their funds growing low. As a whole, 1905 was a very discouraging year. Silent, tight-lipped, and disappointed, they gazed ahead, wondering what the future held.

Before many months went by they knew, for one thing, that it held a man by the name of Flint, a wealthy New Yorker, a member of a big trust company and famous for his powers of organization. On Thanksgiving Day, 1906, one of Flint's men appeared in the Wright shop at Dayton. After looking about and talking with the brothers, he told them Flint wanted to see them. In New York. Would they go?

It did not take the Wrights long to answer, or to get to New York. It took much less for Flint, when he had talked with the men from Dayton, to set aside for

them $10,000 from which to draw and to promise that if affairs developed as he thought they would, the sum would be increased to meet demands. In the meantime, he stood ready to push their flying invention with all his influence and ability.

Such assurance was all the Wrights needed. That spring they went to France and established contacts which later were to bring about the sale of their patents to the French government. They spent the winter in their Dayton workshop building a new plane, much improved over their others in mechanical structure and fitted out with a seat to accommodate both a pilot and a passenger. Early in May they were down at Kitty Hawk, the plane completed. In the group that gathered to watch their first flight was a Virginian reporter. As the machine roared into the air, made a flight at forty miles an hour, and then landed safely, that newspaper man went wild.

So did half a dozen New York reporters when the New York *Herald* flashed the story forth the next morning. Off they dashed to Kitty Hawk to focus field glasses on the Wrights from a secret camp some distance away. They saw the plane lift from the sand, clear the low hills, fly three quarters of a mile, then circle back to come to earth easily. Within another twenty-four hours the remote Kitty Hawk camp had become famous. And the Wright brothers hauled their machine inside the shed doors and shut out the whole gaping world for days.

But they could not stay behind those doors forever. For one reason there was that bid which they had submitted to the United States government some time before, the bid in which they had promised to have a machine ready for trial in August. So they rolled out their plane again. A few days later it crashed and the papers flared forth news of the disaster. What were the Wrights to do now? There were other bids before the government, one claiming to furnish a ship that would carry eight passengers five hundred miles. And there was Alexander Graham Bell's *White Wings* already making successful flights.

But what the world did not know, what even those wise newspapermen apparently did not either, was that the Wright machine which had so amazed them was in reality an old model and that the brothers had not one but several better ones safely stowed away in Dayton. Orville now proceeded to take one of those to Fort Myer to begin making trial flights preparatory to the government test later. There on September 17, after having made most successful flights on previous days, his plane crashed to earth, killing his companion, young T. E. Selfridge, Army Signal Corps man who had had experience in flying with Bell's *White Wings*, and seriously injuring himself.

Before the government test was taken up again, Orville and his sister Katharine crossed over to Europe, where Wilbur had gone earlier and where he had been making amazing flights in France, Spain, and Italy,

winning recognition from the governments which brought about the sale of the Wright patents, and an offer from a group of Englishmen to buy six planes at $25,000 each. Orville, on his arrival in England, demonstrated a Wright plane with Katharine going up with him, and the King watching.

After that, and after a visit to Germany which brought that country into line with others in the purchase of patents, the Wrights returned to America to be welcomed in New York bay with the deafening screeching of whistles and the blare of brass bands while flags snapped in the wind and cheering people crowded the streets to see them go by. Then came banquets, medals, honorary degrees from universities and colleges, to say nothing of the celebration Dayton put on to meet their home-coming and—perhaps—to try to make up somewhat for its earlier lack of faith in Wilbur and Orville Wright.

But there was the government test—begun almost a year ago—still to be finished. The Wrights wanted to make good in that. If they did—if their machine could carry two men ten miles, at forty miles an hour—they were to receive $25,000. If they exceeded forty miles, $2,500 would be added for each extra mile. Of course that would all be very acceptable; even more so would be the recognition of their government, which not so long before had refused to send a representative to Dayton to see the work of two "Ohio cranks."

Well, that government certainly assembled its most distinguished men to see those "cranks" make good their bid on the day set. The President himself was there. So were members of Congress, as well as thousands of everyday Americans, all holding their breath as the Wright plane rose from Fort Myer and set off across rough country to Alexandria, five miles away, with Orville piloting. Almost before they had time to rejoice over that safe taking-off, they saw the machine fly swiftly back, to settle down at its starting place as easily as it had risen. The test had been passed—with two extra miles recorded to the credit of the Wright brothers.

But it is not on record that they talked any more about that triumph than they had about the ones abroad. They made a few flights that summer and fall of 1909 over the heads of curious thousands gathered at Fort Myer. Early in October, New York staged a great celebration to honor the memory of Hendrik Hudson and Robert Fulton. Wilbur Wright was there to fly up from the bay, along the Hudson for the full length of Manhattan, and back to where three hundred years before Hudson's *Half Moon* had nosed along the Palisades, to the fearful amazement of the red men, and where a little over one hundred years before Fulton's *Clermont* had choked, sputtered, belched forth its black smoke and got off on its first trip to Albany.

After that, the Wrights went back to Dayton to set up the Wright Company in America for manufacturing

planes and for improving planes through continued research. Besides that, they began plans for training other men to fly. In 1911, Wilbur made a trip to Europe in connection with the building of army planes. On the first of the following May he was attacked by typhoid fever. At first he was not considered seriously ill. Bishop Wright, then eighty-four, was able to care for him for a time. But he grew worse. By May 26, the doctors said the fight was hopeless. He died a few days later. And the plain frame house, where he and Orville had planned and worked, and where Bishop Wright and Katharine had listened to them and believed in them, was flooded with telegrams and cables of sorrow and crowded with famous men, who came from far places to pay their last tribute of honor to the quiet man who, in his short forty-five years, had aided so mightily the progress of his fellows.

After that, Orville continued as president of the Dayton firm until 1915, when he retired to become a consulting engineer. During the World War he was made a major in the aviation service and plunged into experimenting with death-dealing explosives, which Tennyson had foreseen as the "ghastly dew" raining

> From the nations' airy navies grappling in the
> central blue.

Following the war, he returned to Dayton to the new and lovely home he had built some years before. There he invented an adding machine. There he works in his

laboratory. From there he goes out in summer to a Canadian camp, where he can always fine quiet and relief from public demands.

In the meantime, George Stephenson's traveling engines of a hundred years ago have developed into the ones of present-day smooth-running power, hauling articles of commerce from coast to coast, hauling passenger trains of such luxury and speed as to reduce all land distances to the point where no spot promises for long any quiet or seclusion. What the steam engines have not accomplished for land travel, motor trucks and motor coaches are rapidly bringing to pass. Robert Fulton's *Clermont* of a century and a quarter ago has grown into the ocean liner, a floating palace, cutting the time of ocean travel from weeks to days of the same number. The Wright brothers' timid flights over the sand hills of Kitty Hawk have now extended greatly, bringing the Pacific in touch with the Atlantic almost from sunup to sunset, the Old World with the new within a week's passing. And even before men can adjust themselves to such swift contacts, the very modern streamline inventions are cutting all time and space in travel by even greater breath-taking speed. Within four generations of living, every man, whether he wills it or not, has become every other man's neighbor.

III. *Mechanics of Everyday Living.*

If meeting and knowing the earth's people had been all man needed to live a full life, the inventions of Gutenberg, Morse, and Bell, of Stephenson, Fulton, and the Wrights could easily have met all his demands. Unfortunately, however, he needed food. He needed clothes. He needed protection from extreme weather, from attacks by man and beast. And he needed all these long, long before he built so much as his rude sledge or his dugout, or scratched his messages in picture writing.

To get them he had to have tools, tools to loosen the earth for planting. A forked stick served him for that through many a year. Sharp-edged stones and stout cudgels of wood brought down beasts of the forest for meat. Then came a day when some primitive soul began to grind corn between stones, another to fumble his way through hand-plaited grasses and reeds to a rude sort of loom for weaving. Gradually, out of these simple beginnings, the people of the world found their way through long centuries to the day when each had not only enough to keep his own life going, but, beyond that, a surplus for trading with his neighbor.

As that surplus grew, life in the mere living grew easier for some, harder for others, and increasingly more complicated in its transactions, for everybody.

Men of later centuries, building on what already existed, flashing the light of genius into the shadows of unexplored possibilities, upset old customs of work, thrust old machinery into the discard, and turned whole populations topsy-turvy in revolt.

Richard Arkwright

Such a revolt seethed through old England in the first half of the seventeen hundreds, when the cottage looms of old Lancashire could not supply the demands for their output. They might have come nearer doing so if the necessary thread for warp had been available. Linen thread was scarce and cotton had not yet been produced of sufficient strength or fineness to meet their needs. Since England's trade prestige sprang largely from the textile output of that shire, something had to be done and done quickly.

And Richard Arkwright, shaving and cutting hair in his barber shop at Preston, puttering about with his secret hair dye among the cottages of Lancashire, looked at those looms, heard the constant complaint of the weavers over the lack of thread for their weaving —and began to center his thinking on how to supply that lack. To center it so well that in the end he was to produce a machine that could turn out—turn out in quantities—the very sort of thread so desperately needed. No doubt he did so more easily because all his life he had had to meet his own lack of this and that in his own living.

For Richard, the thirteenth child of an honest but very poor townsman of Preston, had come into the world two days before Christmas, 1732, with little except his shrewd brain to help him win the game of life. Of course there was his uncle Richard, his father's brother, who not only knew how to make the most out of his own slim daily earnings, but seems to have known enough, also, to try to make the most of small Richard. When it came to studying, however, that uncle found his nephew disappointingly slow and without interest; and so, after dragging the boy through the simplest of primers and spelling books, then later seeing him flounder with figures at night school, the older man, apparently, gave up trying to educate his namesake.

Richard, however, even if he did find books dry and hard, found learning to make a living full of sufficient interest to get all he could out of being a barber when he had the chance of serving as apprentice to one in Preston. He succeeded so well that after some years he set up a shop of his own. There he began experimenting with hair dye. He had seen his master's preparation fade with exposure to the weather. He had seen the most expensive wigs of his more prosperous townsmen lose their original freshness. He believed he could make a hair dye that would be permanent in effect.

And he succeeded well enough to start out selling his product among the Lancashire cottages. But that

success, together with his popularity as a barber, roused jealousy among other Preston barbers. Thereupon Arkwright moved on to Bolton. There he began to buy hair for wigs from the women and girls who spent their days weaving in the cottages throughout the shire. Again he prospered, hired a man to peddle his dye and collect hair, and finally considered himself well enough off to marry.

Evidently he was not the only one who thought so. For when he chose for his wife Patience Holt, the daughter of a well-known Bolton schoolmaster, no one seems to have objected. By that time, Richard Arkwright was twenty-two. Life was going along very well and happily for him, and continued to do so for another half dozen years, when his wife died leaving him with a little three-year-old son—another Richard.

In the meantime, Richard Arkwright's thoughts had not all been given to shaving and hair dye. While traveling about among the cottage weavers, while listening to the customers in his shop, he was growing more and more conscious of the ever-increasing clamor for thread rising from the countryside.

Naturally, a young man with Arkwright's eye for opportunity was not slow to realize what it would mean to the man who could supply that needed thread. Very likely, he knew others who were also awake to that same opportunity. It would have been strange if he had not, since there was scarcely a corner of Lancashire which did not have a man puzzling his

brain over the same problem. There was, for example, Thomas High, who after working out a plan for a spinning jenny had, apparently, given up the effort—for a time, at least—and so left his mechanic, Kay, free to accept a proposition to work for Arkwright. When that work was completed, Arkwright rented the parlor of the Preston Grammar School, and with great secrecy set up his frame, completed by Kay from the inventor's design, which required twenty spindles.

Evidently they succeeded in getting the machine in place without attracting much attention. It was well for them that they did. For Lancashire weavers were violently opposed to any sort of machine with which one man could turn out the work it took twenty of them to do. How were the other nineteen of that twenty going to earn their living and feed their hungry families? If Arkwright's twenty spindles had been the only threat to their weaving, he still would have needed to work most cautiously. But there was Kay's old employer, Thomas High, resuming his work. There was James Hargreaves of Stanhill, improving over High's jenny until he had one that could use fifty spindles. That meant doing away with the work of forty-nine strong Lancashire spinners. Outraged men, women, and children surged from their cottages to make short work of those machines and to drive Hargreaves himself out of Stanhill. Undaunted, Hargreaves moved to Nottingham, where he not only

continued his work, but continued for years building his machines for friends before protecting his invention by patent.

For some reason, Arkwright decided to move to Hockley, a suburb of Nottingham, where he built a factory and began operating it with horsepower. In need of funds, he now went to Jedediah Strutt, a well-known, prosperous hose manufacturer, whose successful inventions made him an excellent judge of Arkwright's machines. Always kindly, always interested in any sort of improvement in mechanics, Jedediah Strutt journeyed over to see the Hockley factory, to watch the work of the "machine" set up there, and to vote both worth his backing. So a new firm of Strutt, Arkwright, and Need—the last a partner of Strutt in the Nottingham mills—was formed. All this took place within the year following Arkwright's first engaging Kay to work for him. Life was moving ahead fast for the young barber of Preston.

But not so fast as to cause him to abandon any of the cautious shrewdness which had served him well through his earlier years of plying his trade of barber and peddling his own hair dye through Lancashire. In 1769 he secured his first patent. Two years later, his firm began building the Cromford mills in Derbyshire, near Derwent Water, where they set up machines with fifty to one hundred spindles driven by water instead of horsepower. The company gave Arkwright control of the whole plant.

Immediately Strutt and Need found their faith in Arkwright fully justified. Cromford mills surpassed all others in the price their output brought. Arkwright was constantly at the mill, directing the work and watching the mechanical improvements he continued designing. But no machinery that he or any other man invented could aid the advance of industry as did the factory system which Arkwright established there. With a vision rare in a man of that day, he gathered men, women, and children into his group of buildings, organized and divided them according to their particular skill in varying branches of their work, and proved that in so doing more and better work, greater output, and less friction among the people employed resulted. He paid good wages. He began to consider the living conditions of his people. Later, he built comfortable lodginghouses for boys and girls who came to work in his mill. He financed benefits for his employees as well as for his associates of earlier years.

But there were still the cottage weavers fearing all machinery that took over the work of men. They had operated their own looms in their own cottages for generations. What is more, they resented the fact that those going off to work in the factories were gradually increasing in number. Again the cottagers left their looms, gathered in the market places, talked loud and furiously, and decided to destroy whatever interfered with the clatter and clang of their own looms.

Since the factories of Arkwright's firm were among the largest and busiest of the English textile shires, these discontented people naturally centered their rage on those factories. In an attack on one at Birkacre two men were shot, one drowned, and eight wounded. That happened on a Saturday. Sunday the whole locality seethed. By Monday a mob of eight thousand gathered and descended on the Birkacre mill. When they finished, it was in complete ruins. Others, near by, suffered the same destruction. All machinery was broken and scattered.

To complicate the trouble, manufacturers who were having to pay Arkwright for licenses to use his patent-protected machines joined forces with the enraged workmen by contesting his claims to certain inventions. Why, these manufacturers asked themselves, should they pay Richard Arkwright for his inventions when any man among them could and did use those of Hargreaves, High, and others without cost except for the building?

In 1781, after his firm had answered the destruction of their Cromford mills by building a larger one in Manchester—where the machines were run by James Watt's steam engine instead of by water power—Richard Arkwright began to answer the manufacturers' protests against his claims. He found nine cases of infringement of his patents. He meant to bring the full force of England's justice down on the heads of those found guilty. But he lost the very first case through a lack of clearness in setting forth the description of his patent.

Anyone who thought Richard Arkwright could be whipped by one defeat had no conception of the strength of purpose which had brought him through his half century of fighting to the position he then held in England. He set his jaw. He began preparing a pamphlet of appeal to Parliament. He did very well with it, although not well enough to get his statement beyond the House of Commons. Nevertheless, he kept on pounding. Four years later he won one case. At that time the famous James Watt appeared in his behalf. So did other leading men. And after that he received a real ovation—a cherished experience, no doubt, for the man who had been too busy all his life to celebrate any triumph.

Let it be hoped he did get all there was to get out of that approval of his fellows, for, shortly after, his old Lancashire associates appeared to oppose his second patent on the basis that the invention it protected was not new, not Arkwright's, and—again that earlier protest—that it had not been fully described in the specification. The case was tried in the Court of the King's Bench. At the close of sixteen hours of testimony and argument, the judge decided against Richard Arkwright. This time the celebration was for his defeat and all Manchester took part in it.

Even with all this against him, Richard Arkwright kept right on building up his factory system and perfecting his machinery. He also made a place for himself in the countryside, so much of one that, when

he was fifty-four, his shire made him High Sheriff. With this recognition to comfort him, with a still higher one when George III knighted him for his services, he thought to establish himself becomingly among his neighbors. To that end, he selected a beautiful site above Derwent, and began building a home—a magnificent castle of dressed stone—where he hoped to spend his last years, a revered landowner among his own people. At the same time, he began Crompton Church.

But in the summer of 1792, before either castle or church was completed, asthma, his enemy for several years, conquered his resistance. Workmen hastily partitioned off rooms in the unfinished castle. Luxurious furnishings were assembled for his comfort. Richard, his son, gave him every care. Still, the attacks increased with their painful choking and wheezing until his death, August 3.

He left his son, Richard, the bulk of his half-million-dollar estate. He left his daughter by his second wife a small legacy. To the world, he left, for all time, not only his models for the first power machinery to be used in English textile manufacturing and his ideals for organizing and administering factory labor, but the memory of an indomitable spirit, a wise caution, and a vision for the practical easing of labor which is still heaping high the benefits his life brought the world.

Long before primitive people, squatting in the sun, shot the first shuttles back and forth across their rude

looms, they had begun scratching the surface of some level stretch of earth with those forked sticks of theirs to loosen the soil for planting. In Egypt three thousand years before the birth of Christ, plows were still wooden, but women had given way to oxen in dragging them through the flooded lands of the Nile Valley. The Bible is full of stories, of references, of symbols, based on the grainfields, the olive orchards, the flocks of Palestine. Thirty-three years after the birth of Christ, the Gauls were reaping their grain by means of a cart with projectors which cut off the heads of the bearded stalks. This curious device, however, does not seem to have taken the place then or later of the old-time sickle with which a man could cut all of half an acre of grain in a day! Cut it for threshing out with a flail, clumsily and laboriously.

Here and there, as the centuries passed, the cradle and scythe took the place of the sickle with some farmers. Even so, men and women grew gnarled and bent toiling in their fields from sunup to sunset. Fields were small and few, and yielded but scant harvests for a hungry world. But as that world roused to hear the hiss of James Watt's steam engine, the clatter of George Stephenson's locomotive, the clack of Arkwright's water-powered machinery, farmers began to look out over their land and to wonder whether all the labor it was costing them was necessary. Patrick Bell, a Scotch minister of Fifeshire, began in 1826 to answer that more or less vague discontent by inventing a threshing machine.

Cyrus McCormick

At that very time, across the Atlantic, hidden deep in the lovely valley of Virginia, Robert McCormick was spending long hours, and many, tinkering over a curious-looking machine—a reaper, he called it—in front of his farm's blacksmith shop. As he tapped here, tightened a screw there, or sharpened a queer-cut knife, Cyrus, his fifteen-year-old son, looked on, his fingers itching to be at the thing himself.

For Cyrus had grown up with that queer-looking machine. In fact his father had had his first idea concerning it in 1809, the year his son was born. From the time the boy could remember, he had heard, in season and out, his father talking to the neighbors of Rockbridge County of what he could and would do in his and their harvest fields when he once got the awkward, bulky thing working right. And the farmers listened, some half-believing the man, some with their tongues in their cheeks, and many with real respect for his work.

For Robert McCormick was the prosperous son of a prosperous Scotch-Irish father. Always far more interested in the mechanics of farming than in the actual tilling of the soil, he still was practical enough to make his fields pay, and pay well. When his three sons grew up he bought adjoining land for each of them, until the family estates totaled about one thousand eight hundred acres. He ran a sawmill, a flour mill, a blacksmith shop. He worked in wood and iron. He

studied astronomy and history. He busied himself for days on end with his inventions, turning out, as the years passed, a hemp brake and cleaner, a hydraulic machine, a hillside plow. In the meantime he kept right on trying to complete his reaper.

But Robert McCormick, like all inventors, was given to dreaming dreams now and then. Fortunately for him and his family, there was his wife, Mary Ann McCormick—"Polly" to her friends and neighbors—who, while having dreams of her own, never lost herself in them. She could and did, when necessary, work out in the harvest field raking and binding grain. She kept her house with its big, sunny rooms, its beamed ceilings, its deep fireplaces very clean and shining. She polished—with great pride—the family silver. She watched her peacocks spread their gorgeous feathers and strut in the sun. She drove out, a bit madly and very stylishly, to visit her neighbors. And through all her busy days she held high her ideas of what was becoming for a young McCormick to be and do.

Especially the ideas she had about Cyrus, her oldest son, who even as a barefoot boy dressed in her own homespun, was already showing that he would much rather tinker about in the blacksmith shop than work out in the fields. To be sure, even when very young, he was turning out practical proof that he tinkered to a good end. For example, there was the light cradle he made of locust wood which his young arms could swing without wearying through long, hot hours. There was

also that revolving globe he had completed, a satisfaction to the whole family, with its land and seas picked out quite accurately with colored paints.

But Mary Ann McCormick might have looked a little askance at these ventures of her young son if Robert had not joined with her in seeing that Cyrus and the other children were, early and regularly, in their places in the Oldfield log schoolhouse learning their three R's throughout their young days. Learning well enough for Cyrus to show excellent results from the long hours he sat on his slab bench, dipping his quill pen in homemade ink to write laboriously his spelling, or set his commas according to rule. At odd hours, he played his fiddle, played it joyously. Or rode horseback down through the valley and along dim forest trails—rode so well that long years after city people were to turn and watch him ride by and wonder at the ease with which he sat his horse.

In the meantime Cyrus had a few ideas of his own about what he meant to do and be. With one eye on that reaper, he busied himself with valuable improvements on his father's grain cradle, and with inventing a completely new hillside plow. He was twenty-two before his father finally abandoned the reaper, and left him free to tackle it for himself. Over in Europe, others were recording patents for all sorts of farm machinery—reapers among them. But the valley of Virginia in those early eighteen hundreds was far, far removed from Old World activities. The periodicals announcing them

never reached Walnut Grove Farm with its blacksmith shop, where young Cyrus McCormick was tearing his father's reaper apart and getting ready to build one entirely his own.

That is why, when he finally completed his model, he had, without any aid from the Old World, without any aid whatsoever except that of his own genius, incorporated in it the essentials any successful reaper should have. That was in 1831. Three years later, after many tests of the machine, he took out his first patent. Protected by that, he went ahead making improvements, building new machines—still in the family blacksmith shop and always against what seem today almost unsurmountable difficulties. All his material had to be shipped to him, first by canals, then to Walnut Grove Farm over rough mountain roads. His sickles, six feet long, were balanced across the backs of horses and brought from a distance of forty miles. In 1837, an iron smelting furnace he was conducting failed and he found his funds considerably depleted.

Nevertheless, he kept going. In 1840 he sold two machines. In 1843, he sold twenty-nine for something over a total of $2,900. That was the year he first wakened up to what his reapers might mean to grain farmers on the vast prairie lands of the Middle West. In the Virginia valley, they were welcomed as labor-saving machines which ranked pretty much as other luxuries did. But out where level land stretched away to the sky line, where the soil was merely waiting to be

tilled to yield enormous crops, machine-harvesting had to come if those vast plains were ever to be planted with grain.

Cyrus McCormick determined to see his own reaper and binder do their share toward meeting that necessity. To that end he moved to the Lake Erie shore of western New York, in 1844, to establish a factory for his machines. In the same year his brother, Leander, loaded a supply of material from the old blacksmith shop and started for Cincinnati to set up a branch there. That meant traveling by wagon and water across Virginia, south by boat to round the tip of Florida, and then by sail up the Mississippi and the Ohio to reach Cincinnati. But once there, the McCormick reapers began to travel up the Ohio Valley in ever-increasing numbers. Just as they were traveling east to the Atlantic states and west to the northern part of that valley from the New York factory.

And Robert McCormick, fighting his last fight back in the old farm in Virginia, must have heard the news with gratitude that he was still alive to have his faith justified in his son's reaper even if his own had not worked out so well. Anyhow, he had given his best to that machine of his, just as he had given his best in counsel and understanding to Cyrus, his son. But no man of his years could stand up against a cold he had caught in trying to put out a fire in one of his shops—a winter fire at that. Then on top of the cold he had gone out to his spring planning and planting before he was

quite well. May found him in bed again. The end came in July.

And with it, Cyrus McCormick, robust, successful, just walking out into the full realization of what his reaper might do for the world, bowed his head in the first great grief of his life. Nobody, perhaps not even the son himself, had fully realized until then what Robert McCormick's faith in the invention had meant in bringing about its full usefulness. Nevertheless, that son had, at the time of his father's death, great hopes of what the reaper could do, not alone in the limited New York section, not alone in the Ohio Valley, but in the whole country stretching south from the Great Lakes. And Chicago to him was the natural head of all life in that country. A year later he moved to that city. That was in 1847. Thirteen years later his factory there was selling four thousand machines yearly.

But like the weavers of old England fighting the development of Arkwright's factories, farm laborers in America fought anything, anybody who threatened to lessen their work by machinery. There were mob attacks on the Cyrus McCormick mills. There were also attacks on his patents. Then when he attempted to extend them, he was met with protests, delays, and final defeat. After that he had to sit by and see his rivals in business make whatever use they saw fit of his patented machines without receiving a cent of pay for them.

To compensate somewhat for this loss, he found a grateful world ready to do him honor at the London World's Fair in 1851. Later, the Emperors of France and Austria each made him a Chevalier of the Legion of Honor. The French Academy of Science recognized him as having done more for the cause of agriculture than any other living man. His mother lived until 1853—lived long enough to enjoy seeing the McCormick reaper at last take its place in the sun. With such recognition, with the work of improving his many farm machines, with a home where his wife—Nancy Fowler of Chicago—always met him with understanding and faith, he lived until May, 1884, taking great pleasure in his home and his friends, before whom he revealed a charm and tenderness generally hidden from the world.

He took tremendous satisfaction in the service he saw his machine giving to all parts of the world, opening up vast plains to the cultivation of grain, lessening the burden of farm toil for all men, and bringing the price of bread within easier reach of the poor man. Fortunately for both him and that world, by the time his large Chicago plant was in the heyday of its output, long freight trains were snaking their way across America, the telegraph was clicking off news from the prairies to either coast and on across the sea, and great ocean vessels were carrying his powerful machines to the far-off plains of Russia and to remote

Australia with infinitely greater ease than he, less than forty years before, had ridden those rough roads through the Virginia mountains breathlessly balancing his fearful six-foot blades across the back of his horse. No longer could any man live to himself alone. No longer could any man shut himself in with his own harvested plenty and at the same time shut out the cries of the hungry.

Thomas A. Edison

One very good reason why he could not may be found in the magnificent outpouring of gifts which was to mark the life of a tiny lad born to Samuel and Nancy Edison in the very year Cyrus McCormick was so laboriously moving his factories from Brockton to Chicago. He was born in the thriving little town of Milan, Ohio, February 11, 1847, with nobody, unless it was his mother, having any prophetic measure of the benefits the child was to bring to his fellow beings. Without much ado he was called Thomas Alva. With eyes widely opened so as to miss nothing he immediately got busy, unbelievably busy, with living.

And there was plenty of interest for anyone to find in Milan during those late forties. Great trains of prairie schooners came from the east to roll toward the west on their way to California and the gold mines of that glamorous land. Huge wagons loaded with grain and drawn by four to six horses came thundering into the town—sometimes as many as six hundred of them a day were on their way to ships waiting down in the canal,

Thomas A. Edison

ships which carried not only grain but lumber from the small center out to the lakes and the great world beyond. As Thomas Alva grew older there was nothing he loved so much as to get down to those shipyards, and loudly and lustily join in with the lumbermen singing rough songs of their camps.

Those must have been glorious years for a boy with young Thomas Edison's zest for just everyday living. But when the town refused to permit a railroad to put into Milan, that living promised to grow tame. And Samuel Edison, glancing down through the future, saw the port losing its trade, saw the canal standing sluggish and silent, and decided to move on.

So in 1854, when Thomas was seven, the Edisons left Milan for Port Huron, Michigan. And left the tiny brick house of his baby years for what seemed to the boy to be a mansion set quite magnificently in the midst of spacious acres. Within easy sight was the St. Clair, broadening out to lose itself in Lake Huron. Within easy reach was the life of the town—alive, growing, prosperous. Again Thomas found lumbermen. Again he watched ships loaded and unloaded.

On top of that he helped advertise the view to be had from the top of the tower his father had built on their grounds. He sold tickets to that tower. He talked of its wonders. And people came—came by the score—to climb the winding stairs and gaze out across the lake country. At the same time, he loaded an old wagon with vegetables and fruit from his father's garden, and along

with small Michael Oates, a chore boy, peddled his products up and down Port Huron. That was fun, of course, but fun that also paid as much as $600 in one year to the young merchants.

That was when he began lugging home bottles of chemicals from the town's drugstores and crowding his mother's cellar shelves full of them. With every spare penny he could find he bought books telling him how to perform all sorts of tests. Anybody can see that with all these activities, no boy could or would find any ordinary school of interest. He went, but instead of answering questions, he asked them. Instead of working out his small sums, he drew pictures on his slate. Of course, his teachers voted him slow and doubted very much whether he ever could learn anything even if he gave attention to what they were trying to teach him. When that verdict reached the ears of Nancy Edison, she rose in her might, and removed her small son from school.

For this not only Thomas Alva had cause to thank his lucky stars all his life, but the whole world has also. For Nancy Edison was a brilliant woman and a profoundly wise one. By the time he was nine she had read to and with Thomas such ponderous works as Gibbon's *Decline and Fall of the Roman Empire* and Hume's *History of England*, while he himself had gone through the *Dictionary of Sciences* like a small starved animal. By eleven, he knew his Bible, his Plato, his Shakespeare, and his Homer better than many a grownup, and the

world's great inventors were as familiar to him as his father's neighbors. He was fascinated with geography and traced his way all over the earth's surface with a finger that was never free from chemical stains got from his cellar laboratory. He learned to write a page that was an amazing model of neat, clear, and perfectly formed letters. But he balked at mathematics. And strange as it may seem, never, with all the exact designing and measurements necessary to his later work, was he able to handle alone the mathematical end of his planning.

While following his mother's directions through history and science, he had his own thirst for good stories. He read *Pilgrim's Progress* and Scott's novels, and watched eagerly for new books by Dickens and Victor Hugo, who were then living and writing. And as for *Robinson Crusoe,* he and Michael Oates wanted nothing so much in the world as to have a chance at some lone deserted island such as had given refuge to Crusoe and his good man Friday.

All this reading and studying he and his mother had done joyfully, easily, by the time he announced that he thought he was old enough to begin earning his living. There was the Grand Trunk railway running from Port Huron to Detroit, with a passenger train starting at seven each morning and returning at nine-thirty at night. He thought he could get a job as newsboy on that train. And from selling papers and magazines he would go on to peddling candy and fruit

to the passengers. He delighted his mother by saying he would spend the mid-day in Detroit, between his goings and comings, at the public library. Yes, he had every hour of the day accounted for.

And so satisfactorily that Samuel and Nancy Edison could only agree that any twelve-year-old who could so plan had a pretty fair chance of succeeding in the carrying out of his plans. At least he had a right to prove what he could do. So he applied for his concession, and got it. He wheedled his way into the hearts of the trainmen, who permitted him to store his supplies in one corner of the combination mail, baggage, and smoking car. And on top of that they seem to have said nothing when he began toting his chemicals into the same corner so that he could go on with his experiments as the slow train jogged its way from station to station.

In addition to his work on the train, he set up two stores in Port Huron, one for periodicals, the other to continue his vegetable marketing. The first closed abruptly when Thomas found his partner holding back part of the daily profits. But the vegetable shop did a thriving business. To supplement the products of his father's gardens, the boy lugged to the shop huge baskets of produce from the Detroit markets along with the butter and eggs he picked up at small country stations.

He had had two years of such successful selling experience when news of the Civil War began to flash along the wires to Detroit. Immediately, Thomas saw

his chance and took it. He rushed to the Detroit telegraph operator and bargained with him to telegraph a bulletin headline of the news from the South to stations along his route. That done, he tore off to negotiate for a thousand copies of the Detroit *Free Press*—seven hundred of them on credit. He got them. By the time he reached home late that night he had increased the price of the *Free Press* from three to twenty-five cents, had sold every paper, and had turned away scores of people unsupplied.

No wonder Thomas Edison conceived then and there a high regard for news. If people wanted it as much as he had proved to himself they did, why should he not help to meet the demand by publishing as well as selling it? Before the question had been in his mind many days, the boy was setting type in the smoking car, picking up news from the station masters from Detroit to Port Huron, and putting out *The Weekly Herald*, a single three-column sheet. Then he rolled up a list of five hundred regular subscribers who with three hundred chance buyers added $45 a month to his income.

Life was certainly moving fast for Tom, and profitably. But, while giving enough attention to his publishing, his trade in papers and candy, and his vegetable markets to keep them going successfully, his real heart and best thinking were centered in the smoking-car laboratory. There with a book in one hand he poured out his chemicals with the other to prove to himself whether what the text claimed was claimed truth-

fully. Day after day he worked there oblivious to the trainmen nudging each other to look at him as he bent over his queer-smelling messes, hair tousled, high forehead puckered, clothes wrinkled and stained. But they let him alone.

Or they did until the tragic day when that stick of phosphorus, jostled from its shelf by the speed of the train, crashed to the floor, burst into flame, and threatened to spread through the whole car. Desperately, Tom beat at the leaping blaze with his coat. And then dour Scotch Alexander Stevenson, the conductor, descended upon him. He put out the fire—but with it he also put out Tom Edison and his laboratory, his printing press, his stores of periodicals, candy, and fruit—boxed his ears soundly, and put him out on the next station platform, furiously and finally.

That was a dire calamity. But Thomas was only fifteen. Ahead of him stretched a whole lifetime to make good his loss. Gathering up the wreckage he went home. After considerable hot arguing he got his father and mother to give him an upper room for his precious chemicals, and space for his printing press which he set up in time to run off his next issue of the weekly *Herald*. No, all was not lost, even if he had felt it was that day he had stood in the midst of his belongings, rubbing his tingling ears and looking after the train as it disappeared down the track. Even the rage of Alexander Stevenson cooled down. And Tom was permitted to go ahead with his paper selling.

That is why, shortly after the blaze in the smoking car, he happened to be standing on the platform at Mt. Clemens, waiting for his train, when the telegraph operator's little son toddled out on the ties and caught his tiny foot just as the engine came down the track. Like a flash Tom Edison leaped for the child, seized him, cleared the rails, and fell face forward on a pile of gravel. And the train rolled by leaving both the boy and the baby unhurt except for the unmerciful scratching their faces had received from the gravel.

The baby's father, J. U. Mackenzie, was fairly hysterical in his gratitude. He had no money to offer Tom. But he was a good telegraph operator and he could, if Tom wished, teach him to be a first-class operator. Since Tom had begun to be interested in telegraphy over a year before and to experiment with certain improvements he even then thought the instruments would benefit by having, he was not long in accepting Mackenzie's offer. For three months he worked the greater part of four days a week. Every trainman along the line helped by bringing his papers to him and generally boosting him by their friendly interest. At the end of those three months they clapped him on the back and bade him Godspeed, as Mackenzie told him he could take a job as telegraph operator and fill it well.

Well, perhaps he could. But Thomas Edison thought he might improve his work a bit. So he gave up his newsboy trade, his vegetable market—everything—to

devote all his time to telegraphy. He worked in Port Huron for a time, but his first real job of telegraphy was offered him, at sixteen, as night operator at Stratford Junction on the Grand Trunk up in Canada. He took that job at $23 a month, much less than he had earned as a newsboy—took it because he saw a long, shining road of adventure and opportunity stretch suddenly out ahead of him.

At first, however, that road narrowed down to working from 7 P.M. to 7 A.M. To broaden it he began working on his other experiments in the daytime. Of course that left him sleepy at night. So he rigged up a device connected with the clock to send out automatically his hour signals, and slept. But an inspector discovered the ruse and Edison was fired. After that he went to Sarnia, where, while he was on duty, but through no fault of his, a collision came so nearly occurring that somebody had to pay the penalty for carelessness. Tom Edison was very young. He was new to Sarnia. So he paid by running away from the whole mess.

Then came five years of wandering up and down the Mississippi; of working for the Western Union in Cincinnati, in Louisville; of exasperating his employers by his never-ending schemes for improving his instruments and by awkwardly upsetting chemicals all over his office. He lost jobs. He found others. He rubbed shoulders with the whole midwest fraternity of operators. He increased his speed and accuracy in both sending and receiving messages until he stood at the

top of his profession. Then, suddenly, he grew tired of wandering, tired of shivering in cold rooms, tired of the Civil War wreckage he saw everywhere, and returned to Port Huron.

Not for long, however. For there was Milton Adams, a friend of his Cincinnati days, now in Boston. Adams had promised Tom to help him get a job in Boston if he dared to come East. Tom thought he dared, especially as he could get a pass over the Grand Trunk. So off to Boston he went to find Adams as good as his word.

Those first days in Boston were not easy ones. He and Adams lived together. Neither had much money. Sometimes they were both hungry. Often they were cold. But nothing daunted either of them. Especially Edison, who had just come across the works of Faraday, and was absorbed in trying out everything he found in them. He was not so absorbed, however, as to neglect completing an invention for recording votes in Congress by which he hoped to put a stop to the endless confusion and delays with which that august body had long plagued the soul of every operator trying to get results over a wire. Finally, in October, 1868, he applied for his patent, his first. It was granted the next June. All his savings plus $100 of borrowed money had gone into working the thing out and getting the application granted.

Once it was granted Edison immediately threw up his Western Union job, borrowed more money, and set

off to Washington. If he could get the government to use his device his troubles would be ended. But after nerve-racking delays, after the machine had demonstrated its value perfectly, the deciding committee threw it out. For, as they said, such a concern would end filibustering and make it impossible for the members to change their votes once these votes were recorded.

Discouraged, and more or less disappointed in the men who were running his government, Edison returned to Boston, went ahead with a stock ticker he had had in mind for some time, completed it, and decided to go to New York. By that time he had again spent all his money—borrowed and otherwise. Nevertheless, he left all his belongings—his laboratory equipment, his books, practically everything except the clothes on his back as security for his debts and took the boat for Manhattan.

He landed there in the morning without even the price of his breakfast left. He begged a cup of tea from a tea inspector and got it. He spent his first day hunting up operators with whom he had carried on telegraph conversations. One good-natured fellow, himself out of a job, lent him a dollar. That night Edison carefully selected apple dumplings and coffee for supper as the most filling things he could get for the least money. That dollar had to last him he had no idea how long.

Luckily—far more luckily than he at first dreamed—he found a place to sleep in one of the battery rooms of the Gold Indicator Company. He was there a couple of days

later when Dr. S. S. Laws came tearing madly into the room to find what had caused all quotations to stop suddenly on the floor of the Gold Exchange. Those quotations were being recorded by his electrical indicator—a new invention which Laws had made and with which the Gold Indicator Company had just contracted to supply the Exchange. Everybody was panic-stricken. Hundreds of messenger boys came rushing into the company's office to report the stopping of the transmitter. Nobody seemed to have any idea what to do next.

Except Thomas Edison. Some way or other he made himself heard and announced that he believed he knew what had happened and that he could repair the break. Laws shouted for him to begin. In two hours, all the instruments in three hundred offices were working as if nothing had ever stopped them. The next day, Laws sent for Edison. And Edison went to be put through a fire of questions, rapid searching questions on how he had come to know what he had shown he must know in order to work so swiftly and surely as he had in that two hours. Such questions did not bother Edison. He was on his own ground. It did not take Laws long to discover that, and, having done so, to put the young man in charge of his Wall Street plant at $300 a month. That happened on his third day in New York. The third also for his borrowed dollar.

But what mattered that or anything else? He was in New York with by far the best job he had ever had in

his life. He had taken his chance and by taking it was standing on top of his world. Things were certainly happening fast for Thomas Edison. For that was 1869, the year for which the Patent Office in Washington records by Thomas A. Edison four inventions to improve telegraphy, also the year which saw the setting up of America's first firm of electrical engineers under the name of Pope, Edison and Company.

It was also the year in which Marshall Lefferts, President of Western Union, looking at the enterprising young men of this firm as they tried out successfully their various telegraph and stock-ticker improvements, arranged with them to take over all their transactions. Later he sent for Thomas Edison to make him an offer of $40,000 for his "Universal Printer," —the final result of his stock-ticker improvements— instead of the $5,000 which the young man, with bated breath, had hoped he might get. Blinded, confused by the sight of a check of such size, Edison first tried to cash it without endorsing it, and then when he finally got his name across the back, allowed the paying teller to pay him in small bills which the youth stuffed into his pockets until they bulged, sat up all night to guard, and, only the next day, disposed of, with General Lefferts' help, by opening a bank account.

Shortly after this, Edison opened up a plant in Newark for the manufacture of his stock tickers. Before long he was employing two hundred and fifty men there, running a night and a day shift and acting

as his own foreman for the twenty-four hours. In the midst of this whirlwind of work, his mother died. Perhaps it was the loneliness she left in his life that finally helped him to turn to Mary Stillwell, his capable young assistant, and blundering desperately in embarrassment, ask her to marry him, which she did in 1873.

That same year he made his first trip across the Atlantic to look after his English interests in his automatic telegraph system. But for some reason or other he failed, then, to get the support he had hoped for and returned home to plunge into still further improvements for the telegraph. Finally he succeeded with his multiple transmission so that several messages could be sent over one wire at the same time and in opposite directions as well. Shortly afterwards, Jay Gould, who controlled the Atlantic and Pacific Telegraph Company, offered Edison $4,000,000 in stock for the Automatic Telegraph Company, which owned the invention. Later, Gould repudiated the contract, and, although Edison and his associates sought through thirty-five years of legal action to compel the Gould group to keep their word, not a dollar of the four million was ever paid.

With that Edison decided he had had enough of the telegraph. He had served it long and faithfully ever since the days when he strung his first wire between his Port Huron laboratory and a neighbor's window. He had made money—yes—but had lost far more than he had made. And that in face of the fact that his

inventions were extending the practical use of the telegraph far beyond most men's dreams and heaping high the capital of great telegraph companies.

Fortunately for Edison, he could not afford to stop and mourn his loss. Demands were crowding upon him from his own flaming mind as well as from the world without. He needed some spot where he could shut that world completely away and work without distraction. Perhaps it was in those years that he first began to look upon the deafness which had begun to develop in his early teens as an asset rather than a handicap. He could concentrate within his own silence. Nevertheless he needed further protection from interruption. So he moved to Menlo Park in Middlesex County, New Jersey, and there set up his laboratory, where he could work more or less in peace.

That was in 1876, the year when Alexander Graham Bell stretched his telephone wire in an exhibition hall of the Philadelphia Centennial Exposition and startled the world with its possibilities. Edison, along with others, had worked on that idea. In fact, he had gone so far as to file with the United States Patent Office a description of a similar invention he had in mind. But Bell had beaten him and, with the good sportsmanship which always made him play a fair game, Edison never questioned Bell's claim.

However, there was no reason why he could not begin to improve the telephone as he had begun to improve the telegraph years before. So he shut himself

up at Menlo Park to emerge later with the carbon transmitter. And the telephone spread over the world in a practical use much as the telegraph had done. The Western Union offered him $100,000 for his transmitter, and then a like amount for another invention. By that time, Edison had come to know his own weakness with money. No matter how much he had, he spent it on developing his laboratory, and ended in debt. Now, with $200,000 available at one time, he dared not trust himself. So he asked the Western Union to pay him in yearly sums of $12,000 and thus insure him an income for some years to come.

One year after Bell's voice first carried Hamlet's soliloquy along that wire in Philadelphia, Thomas Edison recited "Mary had a little lamb" into a tube in his Menlo Park laboratory, wound a crank, and grinned back at his men as his voice came faintly out of the machine repeating the story of Mary and her lamb, faintly, but distinctly. Ten years later, in 1888, after he had been granted between sixty and seventy patents for improving his invention, he turned out his second phonograph. By that time he had put $2,000,000 into it.

If that ten years had produced nothing but the improved phonograph at Menlo Park, the world would have had occasion to marvel at the man working there. But there was also that trip he had made to Wyoming in 1878, to test a tasimeter which was to be used by scientists there during an eclipse. He called the weeks there a vacation. And despite the serious work

done, it was one for him—and the first one he had had in all his life. He rode on cowcatchers through mountain passes. He hunted in the heart of Indian country. He mingled with cowboys and sharpshooters.

And then he came back, vividly alive, to shut himself up to begin work on his incandescent electric light. He filled two hundred books with his written notes. He piled his laboratory full of every possible material and device he thought would help him. He surrounded himself with half a hundred tried mechanics who could and would work without sleeping—and eat, in snatches, food brought to them. He played the old laboratory organ while his men sang at their midnight meal. He prodded his financiers to stay by. This lasted for thirteen months. And then on October 21, 1879, while the men sat about tense, white-lipped, and tired-eyed, the current was turned on and light flashed into the glass bulb, and burned for forty-five hours while those men watched. Nobody slept.

But when the light suddenly blinked and went out, Thomas Edison left that laboratory certain of his victory. There would be improvements to make—yes. But he had won. And in the winning not only had he made it possible to turn night into day but he had made necessary a whole new world of electrical manufacturing. Generators, sockets, switches, insulators, plans for central stations, marched forth from Menlo Park—all natural attendants of the electric light.

Five years after the first electric light flashed into being at Menlo Park, Edison's wife died, leaving him with three children. Groping helplessly about in his loneliness, at the end of two years he married again—Mina Miller, a brilliant woman of rare understanding. The next year, 1887, he moved his laboratories to West Orange, where he could have room to expand as his greater activities demanded. About this time he made another trip abroad—a triumphant journey to Paris, where the Edison Exhibit at the Centennial Exposition covered an acre of space with a huge incandescent lamp rearing high above it. All his amazing electrical contrivances were displayed in the buildings, from one of which pealed forth the sound of phonograph records—filling the air with what seemed to be the tongues of all the earth's people. All France, all Europe, marveled at what they saw, and then turned to honor the man whose brain had conceived such wonders.

That man, however, was far too busy to spend much time accepting that honor. He was then forty-two. He wanted to be through with all speech-making, all dining with the great, and get back to his laboratory and to the companionship of men whose mechanical skill could seize his ideas and bring them to perform practical service for other men.

For example, there was that glimpse his mind had caught of moving pictures; the one of a man sitting quietly at home listening to another man talk on the other side of the world; and still another of a storage

battery that would furnish motor power for trucks and streetcars, and bring his electric light into remote country homes. So he came home. In 1889, he had his first moving picture shaking dizzily through a film at West Orange. It was eight years later, however, before he had it sufficiently improved to take out his patent.

As for that voice carrying around the world, he had long since been convinced that there were forces in the air which once harnessed could carry any sound from the click of a telegraph instrument to the music of a symphony orchestra anywhere. Some dozen years earlier he had patented his microphone and half a dozen later his "Edison effect," which formed the basis for the radio tube. When the time was ripe he meant to see what his contribution might mean to the world. That time came, when, recognizing Guglielmo Marconi's discoveries in wireless as the worthiest yet made, he sold his patents to the Italian in 1903.

As for his storage battery—that took his laboratory force ten years to develop. They made around 50,000 experiments in the process, and spent $3,000,000. But when they finally finished, Edison knew he had the best storage battery the world had ever seen. A practical battery that immediately began to serve the world not only in transportation, but in flashing signals to ships and along railways, and in flooding submaries with light in ocean depths. It was early in this ten years that Edison met Henry Ford, when that young man was pinning all his faith to his gasoline engine as the power

best fitted to move his "horseless carriage." Immediately Edison saw the wisdom of Ford's plan, and said so most enthusiastically. Then and there began that friendship which the two men were to continue until Edison's death.

As the old century turned into the new, Edison's mind turned more and more to plans of practical benefit for everyday living. He looked with dismay at the decrease of his country's natural resources. And as he looked he caught the idea of his "magnetic separating mine," by means of which iron ore could be extracted from rock and sand where surveys recorded that such ore existed. Later he found his surveys promising amazingly large but previously hidden sources of the ore. And off went Thomas Edison on a nine-year development of his project—a project so gigantic as to leave men who knew of it gasping in amazement. But just as his New Jersey plant was going full blast, Bessemer steel began to be produced out in Minnesota in such enormous quantities as to send the price of the New Jersey product scudding down to a low level; also to send the New Jersey plant into ruin with huge debts looming up in the background and nothing to meet them.

Perhaps, it was more the thought of those debts than the loss of his own two millions invested in the plant that challenged Edison to his next venture. He had lost fortunes before, and regained them. He had incurred vast debts, and had paid them. In fact, no firm with which he

had ever been connected had failed, sooner or later, to clear up its debts. Now he gathered his forces together—chiefly the forces this time of his recent experience—and decided to pay off those debts by the manufacture of Portland cement. Yes, there were other firms already manufacturing that cement and doing it well. But he believed he could make better cement for less money by inventing machinery to run at less cost. He lost no time trying out his belief. As a result he soon had his enormous New Jersey cement plant erected. He met all competition. He developed that plant until there was none in the world to equal it in quantity or quality of output. And he found a market for every bag of cement he could produce.

And then came the World War, with Edison nearing his allotted three score and ten years. Nevertheless, when the famous "Preparedness Parade" marched along Fifth Avenue with bands playing and flags waving, he led the division of engineers. Later, when the Secretary of War told him America needed him, Edison replied that he was ready to serve—ready and happy, and without recompense. He spent sleepless nights and many of them working for the government in his West Orange laboratories. He turned out scores of new naval inventions and more scores of improvements on others' inventions.

But out of all this, as out of all other experiences, Thomas Edison emerged eager—vitally eager—to share in the great wave of progress which swept over the

world in the first years of peace. Especially eager to ease all burdens of heavy labor, and to give every man his just share of this world's goods. All about him he saw sources of wealth. Wealth hidden from the average man —but vividly present to his eyes. He talked to his friends, Henry Ford and Harvey Firestone. They pooled their interests and decided on rubber as the first material to extract from their ordinary everyday surroundings. By then, Edison had established a branch laboratory at Fort Myers, Florida. There he began experimenting with plants, fourteen thousand of them, and out of the lot found that goldenrod—common goldenrod flaunting itself along every American highway and byway—yielded the necessary content for rubber.

That discovery made, Edison was ready to proceed with his first development of those sources of wealth he saw all about him. What if he was over eighty? His own grandfather had lived to be over a hundred. Why should he not? With fifteen more years, what could he not do for his fellow man?

Every man following his life must stop to wish, as all the world wished that October night of 1931 when Thomas Edison passed on, that he might have had those years, that the world might have had what he could have brought out of them. But surely he had earned his rest if ever man had. Everywhere one turns in today's modern living, Thomas Edison's gifts stand ready to make that living easier, happier, better. Thousands, many thousands, of workingmen draw

wages from activities he set going. Staggering fortunes have mounted for other men who had the vision to turn his genius to serving them. Unmeasured joy and rest have come to the race through the doors he has opened to far-off lands and peoples. But shining high above all these gifts to work and leisure is the gift of the man himself—the gift of a man whose leadership of other men, whose comradeship with those working with him, whose capacity for devotion to friends and family make every other man stand tall with pride.

From age-old picture writing, slowly and laboriously carved on solid rock, to our newsstands spilling over with each succeeding hour's load of dailies. From the human messenger bearing his warning down dim forest trails to a voice over our radio speaking from the other side of the globe. From the days of the hollow log canoe and the oxcart, to these when men cut the heavens above in covering earth's wide-flung spaces. From the field plowed with a forked stick to the thousand acres tilled by machinery. From the handiwork of a cottager to the output of present-day whirring, whanging, fearfully powerful factories.

So runs the tale of man's inventions, no part of which stands alone, no line of which has unrolled without involving the progress, not of one group of men alone, but of all men. Sometimes that progress has brought and is bringing hardship and confusion to many. But, looking back, anyone can see that such upheavals, while

bitter, have been of short duration as measured against the whole of man's progress. Men have learned, in the past, to adjust themselves and their needs. So long as they continue to do so, continue to share the disadvantages as well as the advantages of our so-called machine age, the future promises added ease in living along with a fair content.

PART THREE

Through Human Relations

All are needed by each one;
Nothing is fair or good alone.

—RALPH WALDO EMERSON

I. *Good Neighbors.*

Nevertheless, with all this twentieth century's wealth of accumulated medical science, with all its towering mass of mechanical inventions, life would still be far from easy or happy if those gifts were all that had been offered toward its better living. Fortunately they were not all. In fact, ever since the beginning of recorded history there have been wise men who have considered such gifts as of very little importance in comparison with others which added to the understanding of one man for another.

And as those men so considered they have been concerned, deeply concerned, over the forces they saw rearing ugly heads to destroy what otherwise might have been a community of peace and comfortable prosperity: the fear of one man for another; the craving of a poor man for a rich man's belongings; the resentment of what seemed—and well may have been—injustice. All these and myriads of other destructive forces, disturbing, diverting, the otherwise constructive forces of man's living.

Sometimes those wise men have written down their own philosophy for disentangling these conflicting human emotions. Sometimes they have built up on

their pages fair republics where whole nations shared equally in the world's opportunities, and in so doing reaped a fair reward. Sometimes they have gone out to mingle with all classes of men, to talk with them, and then to sum up their observations in a program for a sympathetic working together of all men for the greater good of their neighbors.

Confucius, the Chinese sage, with his millions of followers; Plato and Socrates, walking and talking in Athens; Christ, living throughout his short thirty years his creed of "love thy neighbor as thyself"; Geoffrey Chaucer, gathering together old England's motley array of men and women and gently laughing their follies out of existence; William Shakespeare, knowing and liking his fellows from clown to philosopher, from loyal servant to king, from milkmaid to lady; Thomas Carlyle, cutting savagely down to the quick of values in man's living; Ralph Waldo Emerson, paying his debt of gratitude to all men who have added "their point of light to our sky"—these and a host of others have built up a source of reflective wisdom whose value no man has yet been able to measure.

But wise sayings might have remained wise sayings if, sometime or other, somewhere or other, still other men had not walked out and by experiment proved them to be possible of practice in everyday living. And because they have, there has grown up a science of social relations comparable in its effect on all human content in living to that of medicine on human health, or of

mechanical invention on human convenience in everyday living.

John Ruskin

All three of these—the science of social relations, of medicine, of invention—are so interrelated as to be as dependent one on the other for their development as are the human beings whom they serve. Since that is true, the science of social relations, after brooding more or less through eighteen hundred years, began to be actively, practically a part of all progress when the inventions of the past century ushered in the machine age and at the same time so upset previous community living that something, somehow, had to be done to readjust it. It was then that a group of young English artists and writers, sensitively alive to the ugliness in workingmen's living relations, started out to see whether something could not be done about them, something besides painting, verse-making, and critical essays.

For example, there was John Ruskin. Son of wealthy London parents, growing up in a home where friction was unknown, traveling in Europe, going to Oxford, writing poetry and art criticism, he looked up and out, one day, to catch fully the human misery heaping high all about him and to say:

> I simply cannot paint, nor read, nor look at minerals, nor do anything else that I like, and the very light of the morning sky, when there is any —which is seldom, nowadays—near London—has

> become hateful to me, because of the misery that I know of, and see signs of, where I know it not, which no imagination can interpret too bitterly.*

He was just past forty when this picture gripped him. Not a youth to be upset by an emotional experience, but a man to whom conviction had come that something was wrong with the way his fellows were living, and that he—John Ruskin—must see what he could do about it. He put himself in the background of the workingman, and was overwhelmed with the hardships he saw from there. Rallying his forces, he set about building tenements where light and air and cleanliness took the place of dark and ill-smelling houses. He established eating places where wholesome food could be bought for a decent price. He formed an association for workingmen where each had a chance to develop a creative side of his being he had never been able to give expression to before. He set up shops all through England's lovely Lake District where the output of these men in wrought iron, carved stone, burnished brass, and vivid tapestry could be marketed. He spent about 180,000 pounds—practically all his inherited fortune—on these ventures. But what he spent of his own precious gifts of mind and soul nobody to this day has been able to count.

Florence Nightingale

During the same years that John Ruskin was growing up in his lovely London suburb and feasting his eyes on

* From *Fors Clavigera*, Letter I.

Florence Nightingale

the shining peaks of the Swiss Alps, a girl was spending her young years in central England quite as free from all contact and responsibility with the other half of her race as he was. Born in old Derbyshire, in 1820, could the girl have heard echoes of that famous old and pompous procession which had celebrated Richard Arkwright's election as high sheriff of her county around thirty years before? She must have done so since the lovely acres he bought in his last years formed part of the estate of Peter Nightingale, one of her own ancestors. She certainly saw some of the bewilderment, some of the helpless, hopeless poverty which marked those years of the early eighteen hundreds when England's workingmen were struggling to adjust themselves to the new industrial demands set up by Arkwright's inventions and factories. Being what she was, a girl of great compassion, such misery must have hurt her deeply. Even so, it probably counted as little to her in comparison with the misery of her fellow beings when gripped by disease or crippled through lack of proper care while sick. For that girl was Florence Nightingale.

In her very young days, when dolls formed the chief attraction for her, Florence Nightingale lavished her care on the old ones, or spent hours doing strange things to repair the bodies of others whose sawdust was spilling all over the nursery floor. As she grew older, she followed her father's gardener about like a shadow. She liked everything he did. She also liked to try everything herself. But hoe and shovel and rake were dropped

whenever she came on a frail little plant unable to hold its own among its sturdier brethern. Nothing in the whole lovely garden of healthy, vigorous growing things meant anything to her until that sickly, fragile bit of life was coaxed to hold up its head and take up its share of full living along with others of its kind.

Just as no healthy, stout animal, no scurrying small beast meant half as much to her as did that shepherd dog she came upon one day with one of his legs broken, his soft eyes full of suffering, and the shepherd about ready to "put him out of his pain." That dog was valuable in keeping her father's flocks within bounds. But more than that he was a living creature who needed help. Everything stopped for Florence Nightingale. She cleansed the injured leg thoroughly. She bound it skillfully. She left clear directions for its care. And she returned day after day to the shepherd's hut until the dog was safe and well again.

Part of this interest was due to her father, who was alert to every live thing about him. Also there was the vicar, her father's friend, often at the hall, often with the girl and her father on long horseback rides over the Derbyshire country—and even more often with her alone when she took supplies to the cottagers on the estate and stayed to watch him take care of some sick person on his visits. To watch him, then to help him, and finally to take over the care herself.

In the meantime, she was studying modern languages with her governess, mathematics and the best in

literature with her father, and music, sewing, and drawing with her mother. Carefully protected, she came on to the years when she began going about in the formal society of her wealthy English neighbors. She was attractive. She had a good time. She went down to London as other girls of her class did and was presented to Queen Victoria—train, jewels, curtsies, and all. She traveled in Europe, rambling through Old World galleries and going on with her languages until she became known as a good linguist.

In between those trips abroad, those gay society ventures, the girl would come back to her home, take up her rides across country, her gardening, and, always, her care of the sick on her father's estate. Gradually, however, she began to realize how little she knew, how little anyone apparently knew of such care. Instinctively she recognized there must be more to be said and done for light, air, cleanliness, and proper food in sickrooms than she heard and saw being done even in London hospitals. Joseph Lister was just then thinking the same, and preparing himself to act on that thinking to protect operative cases in the Glasgow, Edinburgh, and London hospitals. Over in France, Louis Pasteur was also getting himself ready to announce his germ theory concerning contagious diseases.

But in those first years of Florence Nightingale's puzzled wondering, nothing from either of these men had as yet affected the spread of infection. Hospital nurses rushed from the bed of a smallpox patient to

operating rooms without so much as changing an apron. As for cleanliness, this girl found herself facing conditions in hospitals which she would not have tolerated in the sickroom in one of her father's cottages.

By the time she was twenty-one, she determined to stop wondering and see if there was anything she could do to help clear up the situation. The only avenue of approach was that of nursing, and that was practically closed to her as a girl belonging to England's gentry. For nursing, in those years, was generally followed by maids of a lower class and only as a means to earn a living. Generally, but not wholly so, for there were the Sisters of Mercy in Catholic hospitals, who were resourceful, intelligent women who devoted themselves to their work because of a desire to serve. Florence Nightingale resolved to study with those women.

Of course, there was much protesting by her parents and friends. But the girl had set up a goal and, since she had found a road leading toward it, nobody could long keep her from following it. It was to take her thirteen years to come in sight of that goal. Practically all her twenties and beginning thirties were spent under hospital roofs. She visited all English hospitals. She visited those of Paris, Brussels, Berlin, Rome, Constantinople, and Alexandria. She visited the war hospitals of France and Sardinia. And she stopped at a Lutheran Hospital on the Rhine, to study under a deaconess there who drilled her to the limit of that hospital's possibilities.

Equipped with the best training her time afforded, she then accepted a position as superintendent of the Harley Street House, a hospital given over to the care of governesses whose health had broken with years. It was in a sorry financial state when Florence Nightingale took it under her wing. Of course that was why it appealed to her. Here was another weak thing needing help. So she moved in among the sick governesses, and lived there. She gave generously of her own money, she got others to give, she made beds, scrubbed floors, and dosed the patients with medicine. Quite naturally she broke down under the headlong drive to make that hospital over and found herself packed off home to rest.

But England was at war—allied with France to protect Turkey against Russia. In the fall of 1854, the center of fighting was in the Crimea, with the hospital at Scutari struggling to care for the wounded. The British war minister listened to the tales coming in from that tragic center—tales of two thousand wounded men crowded into a space made for half that number, tales of each day's fighting sending hundreds more to increase that two thousand, and on top of that, tales of malaria and cholera wiping out thousands of lives before the men so much as saw a battlefield. Hearing this, the war minister cast his eyes out over England for someone to head the Crimean hospital's nursing staff.

Among all those he saw, Florence Nightingale appeared best fitted to meet his need. To be sure, no

Englishwoman had ever been given a post of such responsibility. But there was something in that thirty-five-year-old woman of Derbyshire that convinced him he would be wise to change the old order. So he asked her to go to Scutari—to pick her own group of nurses to do the work crying out to be done in that tragic headquarters of suffering.

She accepted. Six days later she had left the shores of England with thirty-eight nurses. On November 4, 1854, she arrived at Scutari and walked two miles, in and out, among wounded men lying on mattresses fairly touching each other, many of them still in their uniforms stiff with blood and dirt. Walls were filthy. Vermin swarmed everywhere. The air was stifling. But when she opened a window nauseating whiffs came in from rotting carcasses of animals strewing the ground outside. She saw a sort of stew being cooked in one huge kettle for all the patients.

That was her first day. On the second day she saw scores of freshly wounded men being brought in where she had thought not another one could be cared for. But there they were. And there she was with the responsibility laid upon her to meet the situation. So she met it, although it took her twenty hours that day and twenty the next—hours of tense, never-ceasing, anxious toil—to do it. At the end of her third day she had a place on stairs, on landings, somewhere, for every man.

That done she began on the hospital itself. The dead animals outside the walls were carted away. Windows were opened. Others were cut to let in more air. A laundry was set up where disinfectants were most energetically used. A diet kitchen was established from which issued appetizing food to meet each patient's need. When the supplies at the hospital failed, the new head drew from those on her own ship. Storehouses near by, heaped with plenty but locked by both keys and red tape, suddenly were opened. Orderlies and soldiers found themselves enrolled alongside the women from home, nursing the wounded.

By the end of two weeks, Barracks Hospital stood clean, aired, and filled with comfortable cots. By that time, also, the wounded men were having baths regularly, were being given medicine by the clock, were eating good food, and were beginning to peer eagerly through the night shadows for the gleam of the lamp which marked the coming of this woman among them. They knew her for a kind woman, a woman of mercy. They knew her also as a woman whose force and strength and courage permitted no weakness from any man among them. Just as soldiers and officers alike had by then come to know her as a woman whose power in organization and executive force equaled her depth of mercy for suffering men. As for the people back home, they came to know her, within an incredibly short time, as the one who had cut the death rate at Scutari from 60 to 1 per cent.

Of course they gave her their support. Papers published her lists of needs, and subscriptions poured in to meet them. Englishwomen made clothing, bandages, bedding.

After two years of such service, Florence Nightingale came home. She had cleaned up that war hospital in a way that set a model for all time. In the doing of that, she had seen nine of her nurses die. She herself had been sick and near death's door. So England welcomed her as one who had served to the full.

That was a glorious home-coming. All the more glorious for her, no doubt, because of the long, long years of crippled activity that was to follow. For the strain of those years of Scutari had drained her strength to breaking. Broken and tired she was put to bed. To stay, stay for the fifty years she had yet to live. But what of that? There was her training. There was her tremendous experience. There was her never-ending will to care for the frail and suffering, and there was her magnificent calm, her love of light and sun, her charm which bound people to her in unquestioning loyalty. All England heeded her wishes. It was not long until the activity that radiated from her London home could have put to shame that of many an entirely well citizen of her country.

As an expression of their gratitude, her own English people—rich, poor, soldiers, workingmen—got together a fund of fifty thousand pounds and offered it to her. Yes, she said, she would take it providing she was free to use it for founding a hospital. Whereupon she

turned the amount over to St. Thomas Hospital in London, which was opened with the primary purpose of furnishing high-grade schooling to nurses. But hospitals in those days were mostly given over to those suffering from contagious disease. Florence Nightingale knew very well that in London, as on her father's estate, there must be many not only in hospitals but in homes who needed a nurse's care. So only a few years later when another such school was opened, in Liverpool, she suggested another training school be established—this time for home nursing.

In 1874, the National Nursing Association announced it would provide the same sort of training. Three years later, seventy thousand pounds was set aside from the Jubilee fund to be devoted to this work of training visiting nurses. And the work spread rapidly, not only throughout England but throughout the world. Today, the sight of such nurses, wholesome, sturdy, young, is heartening assurance of a thoroughly trained profession working scientifically, practically, to establish in homes not only a better knowledge of health and sanitation, but an assurance as well of sympathy and understanding.

Certainly those last fifty years of Florence Nightingale's life were filled to the full with service. Beyond that service, not much is known, for she was a self-effacing soul. Nothing better could be found to prove that forgetfulness of self than her exclamation upon hearing someone regretting women's limitations:

> O leave these jargons and go your way straight to God's work, in simplicity and singleness of heart.*

Of course with that ideal in her heart she avoided any public demonstration in honor of herself. But she could not avoid the loyal devotion of England's soldiers who, gathered at a banquet, voted for the Crimean nurse who would live longest in their memories. Every vote was for the "Lady with the Lamp."

Jane Addams

But although she undoubtedly worked with a "simplicity and singleness of heart," equal to that of Florence Nightingale's, another girl—an American girl, Jane Addams by name—can claim far less of accurately accumulated proof for her years of service than the girl from Derbyshire, England, could claim when she passed out of London to the great beyond. For Jane Addams, while always concerned over the sick in body among her neighbors, was more so over the sick in spirit and over the lack of necessities for comfortable living among them. That lack had always been to her like a two-edged sword—not only cutting into the heart of those directly suffering from hunger, from cold, from lack of education, but cutting, quite as sharply, quite as deeply, toward the heart of all citizenship. Cutting deeply for so many centuries that no one individual

***Heroines of Modern Progress*, Elmer C. Adams and Warren Dunham Foster, The Macmillan Company, New York.

Jane Addams

has, up to now, got very far toward healing the festering wounds made by that sword. And much less far in wrenching it loose from the hands wielding it—hands of greed, of ignorance, of the misunderstanding of one group of men by another group of men. Any advance made is difficult to measure by definite statistics such as are used for measuring the number of physicians or nurses, or even the control of disease in a country.

Certainly, Jane Addams, in her very young days out on America's midwestern prairies, never saw herself taking a stand to prove that reforms had been made in her neighbors' ways of living. How could she do so, when there was that curved spine of hers twisting her small back so that she had difficulty keeping straight —even in her own thinking?

That physical handicap became a real tragedy to her when she looked at that adored father of hers, handsomely erect, correctly dressed, as a well-to-do man should be, wearing his frock coat and tall silk hat as an important member of the Illinois State Senate should wear them. How could he bear to have her walk beside him, she asked herself—she with her head turned awkwardly to one side, her toes turned in to help keep her balance? She decided in her own mind that even if he could bear it, he should not. So she avoided appearing with him in public, until one day he met her right in the town's center and then and there killed all her misgivings by lifting his tall hat and bowing low to her as if she were some grand lady.

That father had once been a miller's apprentice who had had to get up at three in the morning and work the long day through. His hands, strong, hard-working hands, gave evidence of those days throughout his life. But so did his mind, and his heart. For long ago in those early hours at the mill he had read every worth-while book in the village library. He had also, sometime or other, stepped back within himself, and balanced the rights against the wrongs of the human race and so had come to possess a sense of justice toward all classes of men.

All that early hardship was a thing of the past and her father had become a prosperous miller in his own right by the time Jane was born in 1860 in Cedarville, Illinois. Probably it was because of her mother's death when she was still a tiny child that her father became the center of her world—a happy, comfortable, prosperous world. Later, when her father married again, her world kept right on being a good place. Near the house where she grew up, a millstream flowed between steep banks along which fascinating caves reached back into black depths, to furnish her and her step-brother no end of exciting hiding places among the sunny low hills that rolled back from that stream. They built an altar. They offered up treasures dear to their young hearts. Very likely the altar flame sizzled and went out under the drenching apple juice they poured over it. But what never did go out of the soul of Jane Addams was the mysterious stirring of those days—

a something that first brought her spirit in a vague contact with that of other peoples and made her dimly, vaguely conscious of herself as part of a whole scheme of world life—past, present, and future.

That consciousness had a way of returning throughout those early years. There was the day, for instance, when she, not yet five, saw the posts of her home gate each topped with two flags—one the red, white, and blue so constantly waving in those early sixties, the other a flag of somber black. Inside the house she found her father, grief-stricken over the death of Abraham Lincoln—his friend, fellow statesman, and President of his country. Straightway, the narrowed path of Jane's life running out between those curiously topped posts broadened and stretched that day to reach all parts of her land.

Then came that other day when she found her father deeply moved over the death of Joseph Mazzini, the Italian patriot. By that time Jane was nearly twelve, quite old enough to stand up and argue that her father had never met Mazzini, that Mazzini had lived and worked in a foreign country, far removed from America and Cedarville, Illinois. What cause had her father to be grieved? But before she finished that talk Jane's sky line had lifted again. Men, her father convinced her, might not speak the same language, might live in far distant countries, and still might be very near to each other through sharing the same hopes and fears for their fellow human beings.

Jane pondered that most seriously. Just as she was to ponder throughout her whole life the problem that faced her one day when she rode with her father through the poor section of a neighboring town and saw for the first time the poverty, dirt, and generally wretched conditions under which other human beings were living. It took that heart-breaking sight to run her sky line up far enough for her to look out and catch the first vision of herself as a citizen with responsibilities to other citizens, as a neighbor who was to know no distinction of class or race among other neighbors. And, right then and there, she not only took a stand against such conditions but so consciously took it that she never again lost sight of the fact that some day she meant to do something to right them.

With those visions of the world and herself in the world, Jane Addams went off to school at Rockford, Illinois. At first she suffered considerable homesickness. But she soon allied herself with a group of girls who were feeling very keenly the wrongs of the world and their responsibility for righting them. That group talked long and hotly, but while talking they really worked and definitely planned to go out from school ready to do their part in that world. Of course those college days were not all given over to talk and dreams of the future. Jane Addams studied philosophy, history, and science. She took part in the intercollegiate oratorical contest as part of the test offered to discover whether Rockford Academy was ready to become

Rockford College. She made only fifth place in the contest—and, according to her own account, was not met on her return with any particular rejoicing by her college mates. Nevertheless, Rockford became a college one year after she left and she returned then to take her B.A. from that higher institution.

The next fall she entered the Woman's Medical College of Pennsylvania, convinced that the only sane way to do any sort of social service was through an exacting study of medical science. In the spring of that year she was sent off to the hospital for treatment of her old-time spinal trouble. And, although she fully expected to take up her study of medicine again, she never did. Instead, after long months in bed, she was advised by her physician to go abroad. Illness had left her depressed, nervously exhausted.

Perhaps that condition was one reason why she reacted so sensitively to the sight of the poor people of London's East End bargaining for a Saturday night's cartload of decayed vegetables and fruit. She saw them, half starved, ragged, count out their few coppers for food fit only for the garbage can. She saw them tear ravenously at those vegetables. And she went away so completely filled with what she had seen that long afterwards that Saturday night meant all London for her.

Even so, she made no definite move then to lessen the misery of which she was so acutely conscious. Instead, on her return to America, she spent her

summers back on her old familiar Illinois plains. Her father had died several years before, but the low hills, the stream, the far hazy sky line of the prairies were all there. So was the Presbyterian Church, which she finally decided to join when she was twenty-five, lonely, as she says, for "some bond of peace, some blessed spot where unity of spirit might claim right of way over all differences."

Two years after her first trip to Europe, she went again. Turning from one to another sickening sight of the way poor men worked and lived, she was always sure that some day she would get about her business of helping those men.

She said, herself, she was not quite certain when she first conceived the definite plan of carrying out that business—the plan which later developed into Hull House, Chicago. But she was quite certain that her years of horror and misery over the sordid living of one whole class of human beings finally culminated in a decision to act after she had attended a bullfight in Madrid, in 1888. There she had sat gazing down into the old Spanish arena after all her friends had gone. She had seen five bulls killed and many gallant horses gored to death. And she had not protested. She had even lost herself in dreams of knights, fair ladies, and tournaments. Returning to her hotel, her friends were not slow in expressing themselves with regard to what appeared to them as her enjoyment of barbaric cruelty. That night a sickening reaction set in. She saw herself

as pretending to want to do something to better man's living—as playing with the idea, but really getting nowhere. She had been letting herself dream just as she had dreamed that afternoon.

Once seeing herself in such a light was quite enough for Jane Addams. Straightway she sought out Miss Starr, a traveling companion and old school friend. The two of them talked and talked again. They evolved what seemed to be a sensible, practical plan. At the end of a month they parted, Miss Starr to stop in Paris, Jane Addams to go on to London, both to talk with others who were already at work along the line they wanted to follow.

By 1889, she and Miss Starr were back in Chicago, looking around in the industrial quarter of that city for a building that could be used as they had planned. They found what they were looking for in a house with wide doors opening into a gracious hall, with large rooms where ceilings were high and windows were numerous and big enough to permit sun and air to come through, with fireplaces promising the comfort of blazing logs, the security of warmth and friendly companionship.

They took that house and called it Hull House from the name of the man who had built it. They furnished it with comfortable chairs and sofas. They added lovely tables and rugs. They completed it with European treasures picked up on their own travels. And when all was ready, they invited their neighbors to come and see them. There were many nationalities

represented among those neighbors and each nationality had brought along its own particular customs from the Old World. As might have been expected, those who accepted the invitation sought out their own groups. Even the coaxing influence of open fires and lovely surroundings failed at first to break down barriers.

But as the whole world knows, those barriers finally did break down, did disappear—until differences in tongue, in nationality, in education, and in culture were swallowed up in a common sharing of interests. That sharing began with the establishment of day nurseries where workingwomen could—by paying five cents—leave their babies to be fed and kept contented during the hours their mothers were away. It continued when a kindergarten was begun to take care of the next older group. By that time, fathers and mothers had concluded that the women in Hull House really understood the meaning of the word neighbor.

Gradually, other interests began to center around those women. Clubs were formed for young people. So were classes for study, for sewing, for weaving. A chorus of workingmen was brought together. Dancing was encouraged. A small theater was equipped and various groups were encouraged to give native plays. A branch of the Chicago Public Library was opened. Exhibits were made of drawing, of modeling done by the neighboring people. Groups were formed for discussing better prices for food, for coal, for housing. Cooperative organizations grew out of these groups to start

campaigns for better service in transportation, in street cleaning, in building tenements.

And visitors began to come—visitors from other classes, from other cities and countries, from other centers similar in purpose, some of which Miss Addams and Miss Starr had studied in Paris and London to get their first practical suggestions for Hull House. From those older settlements, from Hull House itself, men and women took courage to try the experiment in their own cities and towns.

While busy with these neighbors about Hull House, Jane Addams had not forgotten the glimpses she had caught in her childhood—glimpses of the path leading out through her own house gate to the town outside, to the state beyond, then to the nation—not stopping with Illinois, with America, not stopping anywhere until the whole world was connected with her own doorstep. Because she had not forgotten, she became a member of the Chicago Board of Education, President of the National Conference of Charities and Corrections, Chairman of the International Women's Peace Congress meeting at The Hague. She was sent out from this last to present the women's peace petition to the rulers of all warring nations. Leading statesmen received her with deference. And the whole world applauded when she was awarded the Nobel Prize for her effort to bring about world peace.

At home she became a pioneer in working for woman suffrage. She lectured, simply and forcefully, for all her

projects. She wrote with equal simplicity, clearness, and force. Her *Twenty Years at Hull House*, *Spirit of Youth and the City Streets*, *Democracy and Social Ethics*, *A New Conscience and an Ancient Evil*, and *The Long Road of Women's Memory*, all reflect her conception of the new social democracy she saw growing up in the world, a conception born from the age-old wisdom of the Golden Rule which she herself used in living not only among her Hull House neighbors, but among all neighbors the whole world over. A conception which may have its rise in what someone claimed for her as "a patience which includes all men, all sins, all conditions, all prejudices, all superstitions. Whatever else may be said of her, she is largely tolerant."

This patience stood her in magnificent stead when she found her strength becoming unequal to meeting the demands of her day. There was that Tokyo operation of 1923, following a fall while traveling in Japan. Eight years later, at Johns Hopkins in Baltimore, she underwent a second. Never really well after that, she still continued many of her activities at Hull House and some in connection with other interests. On May 3, 1935, she presided at a celebration marking the twentieth anniversary of the Women's International League for Peace and Freedom. She returned to Chicago full, as someone said, of "that zest for living which she always possessed." On May 14, she made her last visit to Hull House. That night she was taken ill. When her physician

ordered her to a hospital, she took her half hour's notice to finish a book she was reading.

The end came a few days later, in the early evening of May twenty-first. She lay in state for a day in the hall at Hull House while her neighbors of nearly half a century, grief-stricken, came to say good-bye. Out in the world, men and women, everywhere, paused to pay tribute. Then, in the end, she was carried back to rest in Cedarville beside her father, among the scenes toward which throughout her whole life she had so often turned as the source of her early dreams and inspirations.

II. *Good Books and Free.*

If just the contact of one neighbor with another next door were all that were needed to bring about such a social democracy, Jane Addams knew that the world might hope to see its full dawn come rather shortly. But with the radio, the screen, the daily press filling eyes and ears with a bewildering procession of other nations, other peoples, other men and women apparently acting and feeling much as any neighbor does, she knew as do all other thinking people that a family living in South Africa is going to have a hard time keeping the boundaries of its neighborhood from extending to include the family in China, in Egypt, along the sunny Mediterranean, or any other place the wide world over where civilization has brought these twentieth-century means of contact.

Usually the sympathy aroused through such contact apparently springs out of some present-day complication in human affairs. But scientists tell the world that behind the present lies the past, and that out of that past comes an inheritance to men and nations with which the human race must reckon in making its measurements of any people, any individual, anywhere. For most people the past can be met and known only in books. Books dealing with all that has influenced the

lives of human beings as far back as man first recorded his achievements and failures. Books for scholars—yes. But even more important than those, books that the common man may have access to and can read with interest.

Through long, long ages, however, books were shut off, locked up as treasures belonging only to a privileged few. Even in America, in the first early days of the young Republic, books were so scarce one wonders how the new nation ever got any vision of world life at all, let alone that magnificent one leveling the differences in birth and wealth which gave all men an equal chance to start life and make of it what they could. In fact it was not until 1803 that America created a tax for the support of free libraries, and then only in scattered communities. Salisbury, Connecticut, was the first town to decree such a tax. As the years passed other towns and states adopted similar laws, but slowly.

Andrew Carnegie

In the meantime, however, across the Atlantic, in far-off Dunfermline, Scotland, a small boy was growing up who was destined to help change all that—a round, plump boy with a large head fairly bursting with things he wanted to know all at once. And he meant to know them if the world offered any means for answering the questions that kept tumbling out of his mind all day long. That boy was Andrew Carnegie, whose vision as a man caused him to see that his own hunger for

books was a universal hunger and to determine to meet it as broadly as his time, money, and the public would permit.

Certainly, there was a long stretch to travel in time and miles between those first years in Dunfermline and the later ones in America before any such vision dawned on Andrew Carnegie. And just as certainly William Carnegie, his father, could have had no hint that his small son would ever make so much as a farthing to give away to anybody. For William, even in Andrew's very first years, was having trouble and to spare in earning a bare living. The fine damask he wove in his four-loom shop was of just as good workmanship as any he had ever woven. And that was saying much, for William Carnegie's skill as a weaver of linens was known for many miles about. But what good was there in such skill if merchants and neighbors could supply their needs, at much less cost, from the factories which a man named Richard Arkwright had started down in England over fifty years or more before? Those factories and the machinery in them had crossed the border of Scotland to oust many a cottage weaver from work—William Carnegie among them.

Fortunately for Andrew he had not only the blood of the Carnegie clan in his veins—a blood that ran hot with independent thinking and living—but he had also the blood of his mother's family, the Morrisons, an outstanding family of intellectual strength and rare

spiritual values. They—the Morrisons—had been shoemakers before they became tanners and leather merchants. And were still close enough to the cobbler's bench, when Margaret, Andrew's mother, was growing up for her to learn how to mend shoes.

William Carnegie, whose singing of old Scotch ballads rose high above the clatter of his loom, and Margaret Morrison, shrewd, thrifty, scrupulously honest, and wise, were married in 1834, and went to housekeeping in a cottage next door to William's loom shop in Dunfermline. The next year Andrew was born to grow strong in body under the bracing days of Fifeshire winters and summers and vividly alive in mind under the teaching of his mother's brother, who gathered in his young nephew to share in the lessons he was giving his own small son.

Because of this uncle's work, Andrew managed to put off going to school until he was nearly eight, when he started to the Rolland Street School of Dunfermline, along with one hundred and fifty other boys and girls—of all ages, all stages of learning—under one teacher. But that one teacher was a whole staff in himself. Every youngster not only had his chance but was urged to take it by the aid of a stout stick. On top of the necessary foundation in reading, writing, and arithmetic, there were some algebra and less Latin available for those clever enough to take it. Andrew, eager-eyed, never apparently forgetting anything he once learned, got from that school about all there was to get—just

as he was to do from every other new situation in the life stretching out so alluringly ahead of him.

Outside of school—there was Dunfermline itself. Dunfermline, bristling with resentment against the machinery which was putting an end to hand labor and marking a rise in class distinctions new to the old Scottish shire. Dunfermline, into which there came rumors of a brave new nation growing up in America. Rumors which stirred the blood of old Scottish clansmen as it had not been stirred since the days of border warfare.

To William Carnegie, forced to sell one of his looms after another, those rumors promised a mighty relief. To Margaret Carnegie, who had opened a small shop to help out the family income, they also promised much. When members of her own family risked all to find out what the new land really held, and then wrote back glowing letters of the opportunities they had found, Margaret looked inquiringly at William over the heads of Andrew and his small brother Tom. William answered by selling the rest of his looms. Then Margaret sold all her scant household belongings. Even with the money from both, they needed twenty pounds more to pay their passage to the land of promise across the Atlantic. Finally, after much hesitating, Margaret accepted a loan from an old friend to complete the amount necessary.

And the family started. Andrew was just past twelve, Tom only four. Traveling across to Glasgow, the family

set out from that harbor to buffet the waves of the Atlantic for fifty weary days before anchoring in New York harbor. After that there were three weeks of travel along the Erie canal, through Buffalo, across Lake Erie to Cleveland, down another canal to the Ohio, which they ascended in a steamboat to Pittsburgh, and from there crossed the river to find final refuge with relatives in Slabtown, Allegheny's drab section of poor hovels, noisy factories, and miserable living.

After such a valiant journey, certainly William and Margaret Carnegie had reason to hope for better days. William immediately hired a loom and set himself to weaving his best damask. But that was the half-century turning point of the eighteen hundreds in America. Life was new and hard along the frontier just beyond the Alleghenies. McCormick's reapers were just beginning to cut a swath here and there across great plains of waving grass and grain. Such linens as housewives needed could still be fetched forth from chests brought from the Atlantic seaboard. So William Carnegie unrolled his wares up and down the valley day in and day out without selling enough to feed his family. Even with Margaret sewing and binding shoes—working at home and in the shop sometimes as many as sixteen hours a day—matters were not easy. Small Tom, Andrew's younger brother, was set to threading needles and waxing thread. Before long William quit his weaving and went to work in a cotton mill.

All of these facts are reasons why Andrew counted himself lucky when he followed his father into that mill to work as bobbin boy, twelve hours a day, for five shillings a week. He had not yet passed his thirteenth birthday. Not long after his first job began he was offered another at two dollars, where, because he could write fairly well, he kept the books of the firm. At first he kept them in single entry. Then one day, somebody told him that all big firms used double entry. Whereupon Andrew and two of his young friends walked to Pittsburgh to attend night school and learn not only double entry but everything else they could crowd into their heads in the hours left after a long day's work. A few months later, he applied for a job as messenger boy in the Ohio Telegraph Company. He got the job at $2.50 a week—and proceeded immediately to wear out his shoes walking the streets to learn names and locations of important men and firms.

Betweentimes he listened to the fascinating click of telegraph instruments. He persuaded one of the operators to teach him how to send and receive messages. He volunteered to sweep the offices so he could come early to practice. Before long he was directing the other messenger boys, assigning them messages for delivery, and drawing $13.50 where the others were drawing $11.25.

That, even in those days, would have meant a full day for most fifteen-year-old boys. But not for Andrew

Carnegie. At the end of that day he and five other boys, calling themselves the "Original Six," took up a course of self-improvement. It was about that time that Colonel James Anderson, a wealthy man, announced he would open his private library to working-boys. A question came up as to whether messenger boys, clerks, etc., were to be included, or whether just those working at manual labor were to have the chance. None of the "Original Six" could answer that question, so Andrew sat himself down and wrote a letter to the *Pittsburgh Dispatch* urging that such boys as he and his group should be included. Colonel Anderson agreed they should be.

Whereupon there unrolled before Andrew Carnegie a world of veritable magic. Every spare second he had he spent in the Anderson library. He read everything—history, philosophy, poetry. Once, after delivering a message to a theater, he slipped into a gallery seat and sat lost to the world as the tragic career of *Macbeth* was unrolled before him. Stumbling from the dim place, he rushed off to Colonel Anderson for a volume of Shakespeare. Week after week he borrowed another. He learned whole scenes from the plays. And, of course, he likewise learned pages of the poems of Bobby Burns to roll them off his native Scotch tongue for the delight of his friends then and throughout later years.

At sixteen he was made assistant operator at $25 a month and given the foreign news to handle. Then he became private operator to Thomas A. Scott, Super-

intendent of the Pittsburgh Division of the Pennsylvania Railroad, with a raise in salary of ten dollars. That meant that he was in a key position—minor but nevertheless responsible—with the company cutting the first railroad through the Alleghenies to Pittsburgh. With a body hardened by long, regular working hours, with wits sharpened by the stiff competition he had met, he stood ready to make the most of that position.

Very shortly he was buying his first stock in the Adams Express Company. To be sure he bought it with money his mother borrowed and with an advance from his employer, Scott. Later when Scott was made Superintendent of the railroad with headquarters at Altoona, Andrew went along with him as secretary, took a comfortable home, and hired a servant to help his mother. In 1859, when Andrew was about twenty-five, Scott became vice-president of the Pennsylvania, and Andrew, his secretary, became Superintendent of the Pittsburgh Division at $1,500 a year. Immediately Andrew surrounded himself with men he knew he could trust—his own brother Tom, his best friend, and made his cousin Marie Hogan operator of the freight station, the first woman telegrapher of the country to hold a position of such trust. Sure of his growing power, Andrew now took a home in the well-to-do suburbs of Pittsburgh and began building up contacts with the cultural side of life, which with the exception of the Anderson library had been pretty much starved in his early years of financial struggle.

He had just got well started in this peaceful living when the Civil War broke out. Scott became Assistant Secretary of War and in that position handled the Union's problems of transportation. He called Andrew Carnegie to Washington. In eight months their department had brought fair regularity and promptness into a situation where confusion had reigned. Andrew got a nasty wire cut across his cheek in the process, and caught his first glimpse of the cruelty of war when he helped care for the wounded after the first battle of Bull Run. The horror of those days was never to leave him. Years later he was to work as few men have worked for world peace. The shock of those early war days, along with the work and long anxious hours of responsibility, tired him out for the first time in his sturdy life, and he fell ill. Given a leave of absence to recover, he used it to make his first visit back to Dunfermline.

He had been away fourteen years. He had left a slip of a boy of twelve, desperately poor, without assets except his strong body and mind. He returned a prosperous young man of twenty-six. Dunfermline, having known the Carnegie clan for generations, having known also the Morrisons, was so excited that a three-day holiday was announced to celebrate Andrew's return. To be sure, the glory of the celebration was somewhat dimmed when Andrew took sick and was put to bed in his uncle's house to stay for six weeks.

After that visit, he returned home, to plunge into the building of sleeping cars, the working of oil lands, and

the development of the Keystone Bridge Works. To these activities he shortly added the work of his steel mills, which with the introduction of the Bessemer process were to grow to such proportions as to threaten to crowd out all other steel interests in America. In 1865 he took another trip to Europe, this time to travel from capital to capital, visiting cathedrals, and art galleries, and studying life in general. A year after his return he decided that he needed to be nearer Wall Street. So he moved from Pittsburgh to New York and set up an office in Broad Street with a sign on the door, announcing "Andrew Carnegie Investments." By the next year his income was about $50,000. In 1878, he took a trip around the world, forgetting even his steel mills in studying the age-old, wise sayings of Confucius and Buddha.

By 1881, he organized Carnegie Brothers and Company, Limited, with a capital of $5,000,000. That was in April. On June first, he sailed for Scotland to keep his long-ago promise of driving his mother into Dunfermline in a coach and four. That must have been a glorious day for Margaret Carnegie. One wishes William might have been along, with his high tenor voice sending out some vigorous old ballad. But William had died years before Andrew had had time to bring much ease to the family. Now, however, with his mother sitting beside him, with all Dunfermline lining the roadside, he rode into the old Scottish town in a whirl of glory. And there Margaret had the joy

of helping lay the cornerstone of the Dunfermline free library, a gift from her own son Andrew.

That must have been a glad day for both Margaret Carnegie and her son. There had been long years and hard ones for both since Andrew had opened his first book in Colonel Anderson's library, and had—then, or shortly afterwards—vowed he would some day do a like good turn for others. He had done that now for Dunfermline. Within his next score of years, he was to fight his way against other interests made fearful by his growing power, to fight and to join forces with Henry Frick, who dominated the great coke industry, to triumph sometimes by fair dealing, sometimes by the shrewd wit that splits a hair between straight and crooked deals in big business. And to reach the first year of the century with a fortune of about $500,000,000. That achieved, he retired.

For that promise connected with Colonel Anderson's library had not been kept to the full with one library in Dunfermline. Nor had that one good turn been the only one he had vowed to perform. He was now nearing the close of his allotted three score years and ten. Whatever he meant to do in keeping faith with himself along other than business ways, he needed to be about. Besides, as he himself was fond of saying, "old age should not be spent in makin' 'the mickle mair,' but in making good use of what has been acquired."

So he turned his back on his steel mills. He turned a deaf ear to Wall Street's shouting frenzy. Sturdy

Margaret Carnegie had died over a dozen years earlier. A year after her death he had married Louise Whitefield. Now he got ready to spend the summers in his magnificent castle on the northern tip of old Scotland. He set aside a room in his palatial Fifth Avenue residence where he could carry on the work of making "good use" of his money. He surrounded himself with great people. He sat among them a good companion, reciting his Shakespeare and Burns, telling story after story, or listening in rapt silence to the sound of his organ for hours at a stretch.

If anyone thinks, however, that Andrew Carnegie had—even in these years—much leisure on his hands, he need only turn to the various interests he set going in that last score of years to find out differently. There are his gifts for education in America and abroad. There is his Hero Fund to aid those injured in efforts to save human life. There is his fund for benefiting the employees of his steel mills. There are his several plans for the advancement of world peace, with the necessary endowment to try out their practical value. And there are his libraries—proofs of the vow he made and kept to make available to people of all classes the books which had once opened up a vast new world to him.

He began this last work in America by endowing a library in Allegheny, where he had spent many a bare hour—for the want of books—in the small drab house in Slabtown. He followed that with another for Pittsburgh. Other large cities received like gifts, as well as

thousands of small towns. Both America and the British Empire benefited. Since he believed—and wisely—that people have a greater regard for the value of a property which they help support, he required that wherever he granted an amount to establish a library the community receiving that gift should obligate itself to take over a fair proportion of the expense in building and supporting it.

Andrew Carnegie retired from business in 1901. In 1912, he announced that he had given away all his fortune except $25,000,000. By that he meant that over four millions of the enormous fortune he had accumulated in fifty years was then placed with the Carnegie Corporation, organized to direct his many philanthropies according to the present-day scientific method of handling such enormous benefits as his. Four years later, he bought Shadow Brook, a lovely summer home in the Berkshires, much more convenient to reach than his castle in Scotland. Perhaps, however, as he grew older, he missed Scotland more than he ever had. At any rate, he brought Scotch bagpipes to Shadow Brook and kept them there to waken him in the mornings with the same wild skirling that had always been the delight of the Carnegie clan in Fifeshire.

But he was then over eighty. So far his short, stout body had met well the heavy demands he had placed upon it. But grippe attacked him. Attacked him just at the time when, stunned over the World War and bitterly disappointed over seeing his own peace

efforts swept aside by a world gone mad with fighting, he was not able to resist the attack. After that, he never quite got back his old-time strength and vigor. But he was strong enough to travel each spring to Shadow Brook and to sit there fishing for hours in the soft cool shadows. One Thursday, August 7, 1919, he came in very tired after a whole afternoon of angling for black bass. The next day he complained of a cold, but on Saturday was up and out in his garden. On Sunday he developed bronchial pneumonia. On Monday morning a little after seven he died. Today he sleeps in the old Tarrytown Cemetery.

Always one side of Andrew Carnegie dreamed dreams and built entrancing air castles. Scattered all along through his years he wrote of those dreams, of his theories—wrote pamphlets, timely articles, volumes, some simple, some ponderous, some homely and direct, some full of high-sounding rules more easily read than lived by. Three fourths of his life he spent getting ready to make those dreams come true. The last quarter he pulled them out of the clouds and amazed his fellow men by materializing them in buildings of stone and marble, in institutions, in shrewd plans to carry them on even after he had left this earth. And he enjoyed his last quarter of living with even more gusto and relish than he had those three quarters when he fought every inch of his way to accumulate the money and power he needed to do what he dreamed of doing for mankind.

III. *Fair Play.*

ONCE when somebody asked Andrew Carnegie how anyone as active as he was could retire, a twinkle came into the small Scotchman's eye as he said, "Perhaps it is because I have something to retire to." Anyone glancing back over Carnegie's life story can find plenty of evidence that Andrew had kept many interests in his life besides those in pullman cars, oil fields, and steel mills. Likewise, anyone looking back at George Stephenson's lifelong love of birds and flowers and all growing things, satisfied in his last years in his gardens at Tapton House, would know that "Geordie the Engine man" had also plenty to occupy him besides persuading the English to use his locomotives. So had Tom Edison—losing himself and his deafness in the music he loved with a passion only equaled by his eagerness to prove that the ideas hurtling about in his brain were possible of practical execution. What is true of these three is true of Morse with his painting, of Lord Lister with his lifelong love of botany, of such a vast majority of other great men of science and business that one must conclude there is in most human beings a craving for some sort of expression differing entirely from that found in work, no matter how absorbing that work may be.

Since play is the direct opposite to work—the most complete letting go of all workday demands of mind and body—men began very early in the world's history to seek out some form of it, some form of relaxation, that would re-create or replenish their zest for living. That seeking has always been universal, knowing no limitations of time or space. Because that is true, there is nothing in all human experience which has afforded and still does afford so common a meeting place for men as their playground. There they forget differences in class and kind, bitterness of business competition, politics—all in the clean give-and-take of good sportsmanship. From there, they go back more ready to see the other man's side of a problem.

Izaak Walton

And no one scene of man's play has given more frequent or more honest return in such understanding than the shady banks of quiet streams, where men have sat long summer hours waiting for fish to bite. Not many men are going to tell you, even if they know, just what those hours do to them. But there is not one among them who would say—even when he comes back without so much as one fish—that those hours have been wasted.

And there is not one of them who does not bless Izaak Walton for standing by all good fishermen in such claims. Surely he knew if any man ever did the sense of quiet security that comes to one as he waits long, still

hours for a tug at his line. For Izaak Walton lived through ninety years of the hottest hatreds, of the bloodiest fighting Old England ever recorded. Years when the Roundheads drove the bewigged, beruffled Stuart Cavaliers into exile, beheaded their king, and set up Oliver Cromwell to rule in his place. Any sort of work or play that could keep a man as gently kind as Izaak Walton kept throughout those years carries with it something more than a basket of fish at the end of the day.

Fortunately for the world of fishermen, as well as for all the world needing his wholesome philosophy, Izaak Walton walked out of his London "sempster and millinery shop" along about 1643. He was then about fifty, a loyal subject of Charles I, a devout Church of England man, but with enough sense to know that life would go on long after the civil war then just starting had waged its destructive way up and down his fair land. Since he was a modest man, he probably did not count his efforts then or later as something infinitely more constructive for human welfare than Oliver Cromwell's endless drilling of his Ironsides in the shadow of old Ely Cathedral.

All, perhaps, that he did stop to consider was that he had brought together a small fortune from his London shop, that he was a bit lonely after the death of his wife and only child, that all about him were the ugliness, strife, and noise of London, while out in the heart of England, in Staffordshire where he was born,

or down to the south, somewhat out of the path of his warring countrymen, there were still quiet fields where he could fish all day long "in cool shadows and cheerful sunshine." Probably it was when he went out of his shop door for the last time that he began so heartily to agree with Diogenes in saying "Lord, how many things are there in the world of which Diogenes hath no need!"

That settled, Izaak Walton went his way to fish, to visit bishops and other church dignitaries, who loved him for his honest friendliness, his faith in God's world, and his satisfaction in simple pleasures. He married again—happily it seems—the stepsister of the Archbishop of Bath and Wells. He bought a small estate near his birthplace, where he knew the fishing was good. But he does not seem to have stayed there long at a time when we count out his long visits among the clergy. He went on with the biographies he had begun writing before he left London, biographies chiefly of men among his Church of England friends. Life stories told with a charm, a quiet humor, that sets those men off skillfully, as poets, hymnmakers, vested clergymen, and just plain men. And he took his fishing seriously. Often he was up and out long before city men were opening their shops. Piscator says to Venator one morning,

> It is now past five o'clock. We will fish till nine and then go to breakfast. Go you to yonder sycamore tree and hide your bottle of drink under

> it; for about that time we will make a brave breakfast with a piece of powdered beef and a radish or two that I have in my basket.

He must have been gratified when other men also took his fishing seriously. For long before he went to sleep in the shadow of the old cathedral of Winchester, he had seen edition after edition of his *Compleat Angler* hungrily seized upon by his countrymen. Since that time scores of other editions have been seized just as hungrily not only by them but by men all over the world.

Tiny volumes for rich man or poor, fisherman or otherwise, to put in his pocket for a day's ramble out in the open. Or to sit with before his own fire with sniffs of the English hedgerows coming up from its pages along with the steady, human philosophy that kept Izaak Walton's own faith secure in God and his fellow men.

But life in the seventeenth century—even with war tearing it to tatters—was a far less nerve-racking affair than it is today, when machinery drives man relentlessly all day—drives him along with a group whose members he may or may not like. By the end of that day, or a week of such days, he needs a change. What is more, his work demands that he have it. If he does not get it, not only he and his work suffer, but so does his whole neighborhood. Fishing is all right, if

he cares for it. So is the mingling with different men in some community center, or the following of another interest through books. But, more and more, students of social relations are urging that in addition to all these quieter forms of recreation, men need, now and then, to lose themselves in some game which calls every part of them—body, mind, and spirit—to full expression.

Of course such reasoning is as old as man himself. And so are the games to meet that reasoning. One has but to close his eyes, to slip back through centuries—countless centuries—to the wooded valley of Olympia, with its gleaming statues and temples, thronged with Greeks waiting breathlessly to see the victors of the day's games crowned with leaves from the sacred grove of olives.

Those were glorious days. Days when men believed they could best honor the gods of their temples by developing a body and mind that worked in harmony to the good of one's self and one's group. Days of such fundamental rightness that after fifteen centuries of being practically abandoned, the world revived them through the Olympic Games at Athens in 1896. Games which, every four years since then, men of all nationalities have come together to watch as eagerly as the Greeks did at Olympia. And the present-day victors have gone back home—Frenchman, Canadian, American, South African, Finn—not only with the honor of having won fame for their homeland, but with a vivid experience with other nationalities to share with their own people.

Not everybody, however, can take part in these Olympic games. Not everybody can join the eager throng who looks on. Of course there are other games, some open only to those who have money, but plenty open to those who have none. Golf, tennis, baseball, football. Each with its own national or international hero, wildly acclaimed today, forgotten—or almost—tomorrow. Each with its own particular rules for playing. Each recognizing certain principles of good sportsmanship common to all fair playing. Principles which once learned put one not only in place with his team but help mightily to put him in place with his race. For, as Babe Ruth once so wisely said, "Ball players know it isn't the individual that counts. It is the way a team plays as a whole."*

Robert Stephenson Baden-Powell

Plays today, played yesterday, and may play tomorrow. For just as there is no today without a yesterday, there can be no today without a tomorrow. No great scientist or inventor ever toiled long days and nights to make some discovery to benefit his day alone. Hippocrates observing the sick in the temples of Aesculapius, Gutenberg experimenting with his printing press, Morse working tensely long, long hours with hope deferred and hunger gnawing desperately, Mc-

* *Babe Ruth's Own Book of Baseball*, G. P. Putnam's Sons, New York.

Cormick crossing mountain barriers to open up wide plains for the harvests that were to feed nations through ages to come—each of them and scores of others toiled in the yesterdays of the world's development to contribute not only for their own time but for all time.

So men and women of today, interested in better relations between all men, in better welfare for the whole world, are keen enough, practical enough to seize upon the younger generation as material with which to work toward a safer world for tomorrow. City and small town neighborhood gangs, farm youngsters out in America's wide open spaces, all these, everywhere, without distinction of race, religion, place in life, are being grouped together with definite aims, with set rules for behavior toward one another, and with an organization that reaches out from one neighborhood to include the state, the nation, and the world. Whether Camp Fire Boys and Girls, 4-H Clubs, Boy Scouts, Girl Scouts, or whatever name they assemble under, the aims and procedure are much the same. And behind each stands some one man or woman whose experience in life, whose natural understanding of youth, helps him enter the background of his younger generation, and from there lead his group forth much as he wills.

The whole world of today recognizes Robert Stephenson Baden-Powell as such a man. Everybody who knows anything of that man's history will recognize also

Sir Robert Baden-Powell

that it was his love of the out-of-doors, his love of matching his wits against nature that kept the boy alive in this man through long, long years of stern army discipline, kept him alive and brought him back to quiet England to find a rare delight and companionship with boys not only of his own island but of the world.

Born in 1857, the son of an Oxford professor living near Hyde Park, London, there does not seem at first glance to be any particular reason why this man should have kept his youth so eternally alive within him. Not on the surface of those bare facts. But there was his mother, daughter of Admiral W. H. Smyth and sister of the Astronomer Royal for Scotland, who brought him not only her father's high standards of courageous obedience, but, it is claimed, a heritage of high adventure, a love of wilderness living from none other than swashbuckling Captain John Smith of Virginia. Then there was his godfather, Robert Stephenson, a builder of bridges. There was John Ruskin, a friend of his mother's, with his curious mixture of interests in men and art. There was William Makepeace Thackeray—a frequent visitor at his home —with his keen understanding of all kinds of people. There he was himself, set down sixth in a family of ten live youngsters. And always there was Hyde Park with its trees, its birds, its lure of the open.

Very, very early in life young Robert Stephenson began to camp and to learn to take full care of himself. He played games with keen relish. He put himself in

the hands of his oldest brother, who was in the navy, and learned to handle a boat in all kinds of weather. When he was barely eleven, with some teaching from his mother and a short time spent at a Dame's school in Kensington Square to prepare him for life among strange boys, he entered a preparatory school—Rose Hill at Tunbridge Wells. Three years later, the Duke of Marlborough nominated him for entrance to Charterhouse. That meant he had made a good record at Rose Hill. With his curly red hair, his freckles, his shining eyes full of laughter, he walked into Charterhouse, a thirteen-year-old boy of medium size, ready for whatever the new scene offered.

As a natural-born mimic who could and would play his fiddle or the piano whenever the boys called on him, he had no trouble in winning a place for himself and keeping it. Even then he did not care much where that place was, just so long as he could keep himself decently clean in both body and mind. He spent hours learning to lay bricks and mix mortar with workingmen so that he could find out something of how those men lived. He played all sorts of games, and was good at most of them—especially at football.

With all these varied side interests, he managed, in spite of hating mathematics and classics, to finish Charterhouse in four years. That was in June, 1876. By September he had taken his examination for direct commission in the army and had passed to stand second in cavalry and fourth in infantry.

And was off to India as sublieutenant of the Thirteenth Hussars, a regiment made famous for its cavalry charge with the Light Brigade at Balaklava. He was gone seven years with but one leave for a visit home. He took to commanding his men as if he had never done anything else. He was popular with them and with his fellow officers. He attended strictly to duty, but he found time to plan for the social life at camp, to hunt in India's tangled tropical forests, to learn all about pigsticking—and to begin those descriptions and drawings that continue to give such fascinating reading to all men who love life in strange lands.

In 1883, at the end of his first seven years, he was appointed adjutant of the Thirteenth Hussars and promoted to captain. The next year, still with the Thirteenth Hussars, he was ordered to Natal, where he had his introduction to the South Africa he was to live for, fight for, and help win for England, within the next eighteen years. During those years, he was to hunt big game in Africa, to put down native revolts, to serve under his uncle, General Smyth, on the island of Malta, to be given command of the Fifth Dragoon Guards in India, and finally to return to South Africa to raise a force for the protection of the Bechuanaland-Rhodesia frontier of five hundred miles, before the South African War—long brewing—finally broke out.

All this time, he had continued his own characteristic way of attending strictly to his business as an officer in the British army, while at the same time never

forgetting—what was to him equally important—the business of living among his men as a social human being. At Malta, he had organized a Soldiers' and Sailors' Club financed by money earned at concerts he had arranged. At Meerut, he had set up a dairy, built a bakery, a soda-water factory, a kitchen based on sanitary rules. At the same time, he had been president of the Meerut Dramatic Club, secretary of its pigsticking club, had taken leading parts in plays, gone hunting, and had his pictures exhibited at the Simla Academy.

He needed all that experience and more when he found himself in command of the British forces at Mafeking during the famous siege of 1899 with the whole world looking on to see whether the Boers or the British were to gain final possession of the town. For Mafeking was the center of trade for Cape Colony, Rhodesia, and Northwest Transvaal. Whoever held that center held all of South Africa. With tremendous odds against him Baden-Powell prepared for the siege, and then held out from October till May before the Boers were forced to yield. That over, he found himself a major general because of the defense which, Queen Victoria wrote him, he had "so gallantly maintained under resourceful command."

Of course England was grateful. That was but natural. But it was the young population of the Empire, the children, who turned the full tide of their hero worship upon the commander at Mafeking. They

named their pets for him. They wrote him. They held themselves in leash by main force until the war was ended in 1902, and, with South Africa completely policed and quiet through his plans, the victorious commander was free to turn his face homeward. Then they shouted their young throats hoarse in the welcome England gave him.

Five years more were to go by before Robert Stephenson Baden-Powell was to give his full attention to those shining-eyed followers of his. The first of those years he was to spend as Inspector General of Cavalry, visiting camps and inspecting schools. Later he was to return to the Cape with the Duke of Connaught. He was to complete his African sketches, to exhibit one hundred and twenty-five of his drawings, and to show a bust of his lusty old ancestor John Smith at the Royal Academy.

At the same time, he was to find his *Aids to Scouting* in the hands of school boys and girls all over England. He had written that book for his soldiers—grown men. But the way those youngsters were devouring it and following it no doubt led him to turn his full attention to a plan long lingering somewhere in the back of his mind. A plan which no doubt had its beginning back in the cope of the Charterhouse days, and which had lingered together with what he wrote to his mother close to a score of years before as "a sort of hunger to be out in the wilds."

Finally he got that plan down in 1906 in the form of an outline headed *Scouting for Boys*. He sent copies to men in the army, the navy, the church, and the government. Those men called it good. The next year—1907—he went about lecturing on the idea. Early in 1908, he began publishing *Scouting for Boys*, in serial form, one part every two weeks. Before twelve weeks were over, troops of Boy Scouts were forming all over England.

The next year ten thousand Boy Scouts gathered at the Crystal Palace in their first big rally. It was that year, also, that England's King knighted Robert Stephenson Baden-Powell, knighted him for all his years of brilliant service in the army—yes—but quite as much for the work he was doing toward building up a loyal citizenry through the Boy Scouts.

In 1910, Sir Robert retired except for his Scout activities. To be sure, those were quite exacting enough to fill any man's day. Later, when he married, his wife took up the scattered group of Girl Guides, and brought them into an organization similar in form and strength to that of their brothers. Today, the story of the work those two have done and are doing is told by the growth of the Boy and Girl Scout movement. A growth that now is measured not by any one nation but by representatives coming together from countries all over the world in the international jamborees—representatives of millions of young people who have followed the command of Sir Robert, Chief Scout,

to "Train your Scouts as individuals and then harness that individuality for good of the whole!"

Human beings, however, trained as individuals are not easily harnessed "for the good of the whole." Not easily. Perhaps that is one reason why this science of human relations is only beginning to take on form as an organized, permanent influence for man's progress. That and the fact that only within the last century have inventions in travel, communication, and work thrown men of all classes and countries into bewildering contact.

Out of that contact come new competitions, new rivalries, new ambitions. Conflicting beliefs fill the air with a babel of tongues. Prophecies and counter-prophecies echo and reecho. In the midst of this confusion, man becomes more and more conscious of the need of some common philosophy, some simple principle for living at peace—not just with his neighbor next door, but with his whole race.

As that need grows, the new science of human relations takes on added meaning and power. The sayings of wise men in past centuries become practical rules for modern living. Sociologists, economists, philosophers—those scholars standing behind all social welfare—begin to speak a language common people may understand. Heads of great industrial concerns equip their plants to bring comfort of mind and body to their employees. City governments put forth pro-

grams for better housing, better working conditions, better recreation facilities. All sorts of organizations stand ready to equalize opportunities.

So much for the past and present of this new—and yet age-old—force for man's betterment. What of the future? Will the next century or the one following mark advance or retreat? That is a question many men are trying to answer today, and without much success. Nevertheless, measuring the possibilities of growth of this third element of man's progress against the past development of medical science and mechanical inventions, are we not safe in concluding that the chances for the third will, at least, be equal to those of the other two?

And the man lifting his head from the confusion that besets his days—what has he to offer as his share toward a more understanding living among his fellows? What better than that which Albert Einstein offers when he says with the humbleness of the truly great:

> A hundred times every day I remind myself that my inner and outer life depend on the labour of other men, living and dead, and that I must exert myself in order to give the same measure as I have received and am receiving.*

* From *The World As I See It.* Albert Einstein. Covici Friede, Inc., New York.

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